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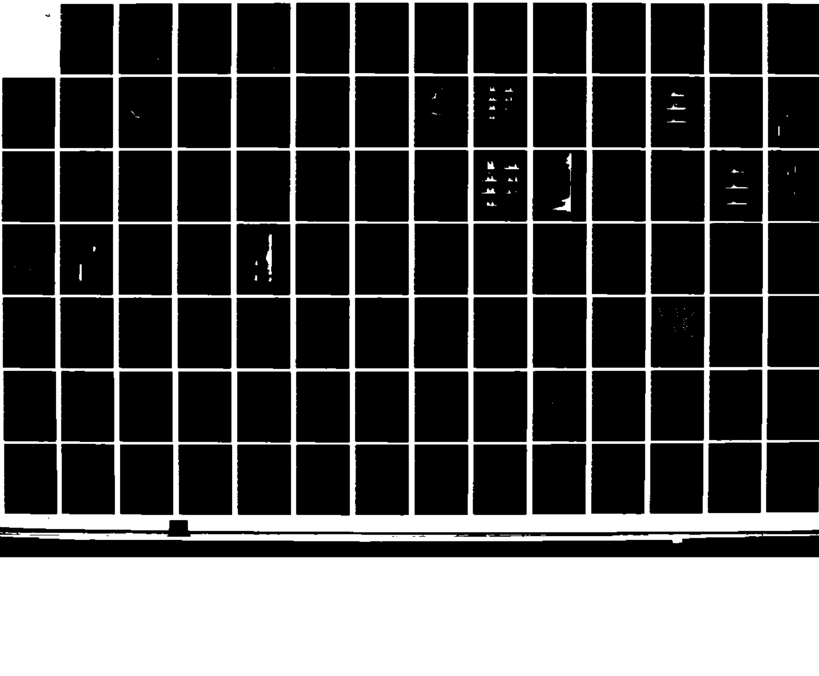

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The Wake Island Hydrophone Array has been successfully upgraded from a 3-channel slow-speed analog cassette system to an 11-channel computer controlled digital system for continuing research on Ocean P (Po) and Ocean S (So) phases, as well as normal, mantle-refracted P phases from underground nuclear explosions and earthquakes at great distances.

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Features of the upgraded system are a large dynamic range (events from at least 4.0 to 8.0 mb can be recorded without distortion), absolute timing accuracy to 1 msec, interchannel timing accuracy to 1 msec, digital recording for ease of processing, and a 40 Hz Nyquist frequency for recording frequencies actually observed in Po/So at large distances.

Software development for compression and efficient management of the data has been successfully completed with master tapes sent to DARPA's Center for Seismic Studies for use by interested investigators.

Research papers on Po/So phases have reported on the frequency content and propagation velocities at the Wake hydrophones and across a 1600 km long deep ocean hydrophone array. At a distance of about 18° ($\approx$2000 km) frequencies for Po/So are as high as 30 and 35 Hz, respectively; at a distance of about 30° ($\simeq$3,300 km), as high as 15 and 20 Hz, respectively. The travel time equations which successfully model all Northwestern Pacific shallow-focus Po/So first arrival data collected by the Hawaii Institute of Geophysics since 1963 at epicentral distances greater than 12° are $T = X/(7.96 \pm 0.05 \text{ km/sec}) - (7.14 \pm 2.38 \text{ sec})$ and $T = X/(4.57 \pm 0.04 \text{ km/sec}) - (14.03 \pm 5.31 \text{ sec})$, respectively. Values for a frequency dependent Q are found to range from 625 ± 469 at 2 Hz to 2106 ± 473 at 13 Hz for Po and from 1401 ± 296 at 5 Hz to 3953 ± 863 at 15 Hz for So. This could alternatively be described as an average attenuation of -21.5 ± 0.9 dB per 1000 km of travel path for both Po and So at all frequencies studied.

Regarding published research on normal-mantle refracted P phases, spectral comparisons for earthquakes and explosions have been completed and published. Expected differences between the spectral signatures of explosions and shallow focus earthquakes at great distances (the nuclear explosions being relatively stronger at high frequencies) are reported. The recording of a small explosion and improvement in its S/N ratio through some elementary enhancement techniques are also discussed.

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INTRODUCTION

General Objectives

General objectives of our research in deep ocean seismology can be summarized as follows:

(1) to determine the mechanism for the generation and propagation of Po/So phases; and

(2) to utilize the low noise levels at high frequencies (i.e., > 2 Hz) of the deep oceans and the relatively large amplitudes observed in P at those high frequencies from events at great distances (i.e., >> 30^{o}) to gain new insights into: (a) differences in spectra associated with source characeristics, and (b) the physical properties of the deep mantle.

In the past two years the principal means for achieving these objectives has been through the acquisition of data from hydrophones and ocean bottom seismometers located near Wake Island.

Specific Objectives

Specific objectives of an applied nature which we believe may be of interest to AFOSR are the following:

(1) the relationship of Po/So spectra to focal depth and source parameters;

(2) spectral comparisons of normal, mantle-refracted P phases at great distances from earthquakes and explosions;

(3) estimates of the coherence of seismic phases recorded on the deep ocean floor; and

(4) comparisons of S/N ratios for phases recorded on the Wake hydrophones, ocean bottom seismometers, and ocean sub-bottom seismometers.

The specific means by which AFOSR has contributed to our efforts to achieve these objectives has been major support for the upgrading of our Wake Island hydrophone array (partial support being derived from ACDA) and for the analysis of data acquired by: (a) the upgraded station, (b) the original three channel Wake system, and (c) other ocean bottom instrumentation in the Western Pacific.

Reasons for Interest

Reasons why these applied objectives may be of interest follow.

(1) For oceanic travel paths out to distances of about 3000 km, Po/So phases have signal-to-noise ratios generally at least ten times greater than the ratios of their respective normal, mantle-refracted P and S phases; and, in many instances, no P's or S's can be found in spite of

the presence of very strong Po´s and So´s. Therefore, the detection and discrimination of underground nuclear explosions at distances less than about 3000 km in an ocean environment requires an understanding of Po/So. Most important could be any possible relationship of Po/So spectra to focal depth and/or source parameters.

(2) Normal, mantle-refracted P phases recorded at great distances (i.e., 60° to 90°, or approximately 6700 km to 10,000 km) have substantial amounts of energy at high frequencies (i.e., 2 Hz to 10 Hz). Such phases from earthquakes and explosions are well recorded in the low noise environment of the deep ocean. [Estimates of noise levels on the Wake bottom hydrophones in the 2 to 10 Hz range are comparable to those of the best continental sites.]

(3) A major concern in the analysis of underground explosions by seismic methods is the reliability of yield estimates. Much of the scatter in yield estimates is due to inconsistencies between the waveforms from different stations, and even between the waveforms from elements of continental arrays with apertures the size of the Wake bottom array. These differences may be attributable to variations in the response of the continental crust underlying these arrays. Signals recorded in regions where the crust is very thin (i.e., under the deep ocean basins) may have higher coherencies--thereby providing a means for improved estimates of yield. The Wake array is an ideal tool for evaluating this hypothesis.

(4) In recent years some members of the "detection and discrimination" community have demonstrated a substantial amount of interest in ocean sub-bottom instrumentation. The level of this interest may be best manifested in DARPA´s commitment to develop a working sub-bottom system--the "Marine Seismic System" or MSS. Anotner sub-bottom instrument which has been developed (this at HIG through ONR sponsorship) is called the "Ocean Sub-Bottom Seismometer" (OSS). A reasonable presumption is that S/N ratios for ocean sub-bottom systems would be greater than for existing bottom systems (i.e., ocean bottom seismometers or ocean bottom hydrophones), resulting in a higher sensitivity (or lower detection threshold) for the sub-bottom instrument. A possible alternative to a sub-bottom instrument is an array of bottom instruments such as ocean bottom seismometers or ocean bottom hydrophones, with enough elements to make up the difference in S/N. Essential requirements to achieve an increase in S/N are incoherent noise and coherent signals in the frequency band of interest. Advantages of such an array over a sub-bottom instrument may be in cost, in ease of deployment, and in studies requiring an array. With the continued operation of the eleven element deep-ocean hydrophone array near Wake Island. these questions may be answered through further comparisons between signals recorded by the sub-bottom systems and those recorded by the Wake hydrophones.

PROGRESS

Upgrading of the Wake Island Hydrophone Array Recording System

Upgrading of the recording system for the Wake Hydrophone Array, from a 3-channel slow-speed analog cassette system to an 11-channel, 16 bit, computer-controlled digital system, was accomplished by September, 1982. Some of the advantages of this new system are: (1) a large dynamic range to record, without distortion, events ranging from at least mb = 4.0 to mb = 8.0 (i.e., 16 bits = 96 dB); (2) absolute timing generally accurate to 1 msec (for ease in processing, no time correction needs to be applied to acheive this accuracy);(3) interchannel timing accurate to within 1 msec; (4) a digital recording format such that only a minimal amount of processing is necessary to convert the data to a widely useable format; (5) the capability to record all eleven available hydrophones; (6) the recording of frequencies at least as high as those already observed at Wake in Po and So (i.e., a 40 Hz Nyquist); (7) operation of the system so simple that it can be accomplished by the personnel at Wake who are untrained in computer hardware and software; (8) required servicing (i.e., changing tapes) no more than once per day; and (9) the capability of restarting automatically after power failures (which occur frequently at Wake).

The recording of data from all eleven available hydrophones produces four full-reel computer tapes per day requiring four tape drives to maintain a maximum of once per day servicing by an operator. Several problems which have occurred with the tape drives have made it necessary to record only eight of the eleven hydrophones (thus producing only three tapes per day) during most of the recording period. All other losses of data, including those caused by power-failures, amount to less than 3% of the total data collected.

Once the data on computer tape are received by HIG, an efficient compression and management of the data must be accomplished. Uncompressed, the data could amount to 1460 tapes per year, requiring a large space for storage and being inefficient to access for study, or to copy and transmit to other scientists. Software has been developed to compress this data to approximately 15% of its original volume and at the same time catalog all of the saved data for easy accessibility. Sections of data saved correspond to arrivals from events, and the raw data are also randomly sampled for future quantification of the temporal characteristics of ambient noise levels.

Compressed data tapes have been sent to the DARPA Center for Seismic Studies (CSS) for use by other scientists.

A complete description of the digital recording system at Wake, the data compression software used at HIG, and the tape format for data sent to CSS is contained in Appendix IX. A list of events for which the times of possible arrivals have been saved on the CSS compressed data tapes is contained in Appendix X.

Po/So Spectra vs. Focal Depth and Source Parameters

Although this was one of our original research objectives for AFOSR, no direct progress has been made in this area. Factors contributing to this lack of progress have been:

(a) the re-direction of efforts towards topics more readily resolved, of more immediate interest, and/or of greater apparent importance;

(b) anticipated improvements in instrumentation (i.e., the upgrading to a digital, rather than an analog system) which would greatly facilitate the data reduction required for this task; and

(c) the small number of events with very shallow focal depths (<10 km).

Indirectly, a great deal of progress may have been made towards the achievement of this objective. [It is unlikely that relationships of spectra to focal depths and source parameters could be postulated in the absence of a generally acceptable model for the generation and propagation of Po/So phases.] Evidence of continuing progress in Po/So research may be found in: (a) recent publications ("Oceanic Pn/Sn: a qualitative explanation and reinterpretation of the T-phase" by D. Walker; HIG Report 82-6; and "Spectral characteristics of high-frequency Pn, Sn phases in the Western Pacific" by D. Walker, C. McCreery, and G. Sutton; op. cit.); (b) the formation of an Ocean P Alliance with the publication of an OPA newletter; and, (c) important advances apparent in analyses of data acquired by the ONR sponsored OBS Wake array experiment reported at the recent fall AGU meeting and now in draft form in preparation for publication. ("Po/So Phases: Propagation Velocity and Attenuation Across A 1600 km Long Deep Ocean Hydrophone Array" by D. A. Walker and C. S. McCreery).

We should note that with the upgraded system we have recorded two shallow focus events (15 km and 17 km depth) from the Marianas at distances of about 18^{o} and one intraplate (and presumably very-shallow focus) event from approximately 12^{o} to the west of Wake. The Po/So phases from these, and other, events will be useful in evaluating Po/So as a possible discriminant.

Spectral Comparison for Earthquakes and Explosions

Spectral comparisons between earthquakes and explosions have been completed and are the subject of a pubished paper ("Spectra of nuclear explosions, earthquakes, and noise from Wake Island bottom hydrophones" by C. McCreery, D. Walker, and G. Sutton, Geophys. Res. Lett., 10, 59-62, 1983.) The data examined show expected differences between the spectral signatures of explosions and shallow focus earthquakes at great distances--the nuclear explosions being relatively stronger at high-frequencies (or weaker at low-frequencies) than earthquakes. Also, a small explosion has been recorded with a significant S/N ratio on the Wake hydrophones. A unique aspect of hydrophone recordings is that the ocean surface reflection (recorded at a time after the main P corresponding to twice the water depth divided by the velocity of sound in water) can be used to increase S/N ratios.

Estimates of Coherence

Comprehensive estimates of coherence and possible improvements in yield estimates are a major topic for investigation in the coming year using data acquired from the expanded hydrophone array. Some preliminary estimates of coherence have already been made. These estimates are appended to this report.

Comparisons of S/N Ratios

In September of 1982, DARPA and ONR conducted tests (the "Downhole Experiment") in the Northwestern Pacific relating to sub-bottom seismic instrumentation. Successful deployments included OBS's and HIG's ocean sub-bottom seismometer (OSS). During the same time the expanded Wake system became operational. Preliminary comparisons of S/N ratios for the Wake system and the available downhole data have been made. They are appended to this report. Additional comparisons were (and are being) made after the OSS data was retrieved from its recording package on the ocean bottom in the summer of 1983. These comparisons will be the subject of a future report.

SUMMARY OF ACCOMPLISHMENTS

Major accomplishments supported in whole, or in part, by AFOSR since 3 March 1982 follow.

(1) Successful upgrading of the Wake Hydrophone Array recording system from a three-channel analog cassette system to a sixteen-channel digital system. Some of the advantages of this new system are: (a) the ability to simultaneously record all of the active hydrophones in the array; (b) a 96 dB dynamic range; (c) millisecond accurate absolute and cross-channel timing; and (d) a digital format which allows immediate processing of the data.

(2) Development of software to compress and manage the digital data collected at Wake. This data is compressed by saving intervals of data in which seismic phases of interest are known or suspected to be present, and by saving regular intervals of data for sampling the ambient noise levels. These compressed data are stored on magnetic tape files which are catalogued on paper and in computer files for easy reference.

(3) Preparation of a report on items 1 and 2 above ("The Continuous Digital Data Collection System for the Wake Island Hydrophones" by C. S. McCreery).

(4) Distribution of the Wake digital data through the DARPA Center for Seismic Studies (CSS). Compressed data tapes containing known or suspected seismic phases are being routinely sent to CSS for access by others who may have an interest in this data. Investigators at Rondout Associates Inc. have successfully accessed the data through CSS. A list of intervals, and the events and phases, which they represent, is contained in Appendix X. The event format of the data also is described in Appendix IX.

(5) The observation and characterization of differences in spectral signature between P from explosions and P from shallow focus earthquakes recorded on the Wake bottom hydrophones. The observations reflect differences in source spectra between explosions and shallow focus earthquakes. For similar magnitudes, explosions had more energy at frequencies above 2.0 Hz and less energy at frequencies below 1.5 Hz.

(6) The enhancement of S/N of an extremely small explosion by signal stacking to a level near that for perfectly coherent signals.

(7) The publication of a report on items "4" and "5" above ("Spectra of nuclear explosions, earthquakes, and noise from Wake Island bottom hydrophones" by C. McCreery, G. Sutton, and D. Walker; op. cit.).

(8) Continuing analyses of Po/So phases with additional spectrograms and discussions submitted for publication ("Spectral characteristics of high-frequency Pn. Sn phases in the Western Pacific" by D. Walker, C. McCreery, and G. Sutton; op. cit.).

(9) The formation of an "Ocean P Alliance" with the publication of an OPA Newsletter to stimulate interest in, and research on, Po/So phases.

(10) The evolution of a qualitative explanation for the propagation of Po/So phases consistent with many observations of these phases throughout the western, northern, and central Pacific.

(11) The discovery of a probable relationship between Po/So and T phases.

(12) Publication of a report discussing item "9" and "10" above ("Oceanic Pn/Sn: a qualitative explanation and reinterpretation of the T-phase" by D. Walker; HIG Report 82-6.)

(13) Preliminary comparisons, with available data, of the Wake hydrophones to ocean bottom seismometers and the OSS. It should be noted that these are merely preliminary studies and in some cases the comparisons made are of an indirect nature. Nonetheless, it would appear that the Wake hydrophones may be comparable to the OSS in terms of S/N ratios, considering possible improvements through array processing. Direct comparisons to MSS are not possible since that system was not successfully deployed in the Pacific. Regarding the comparisons of Wake to ocean bottom seismographs. we have observed with data from an ONR sponsored OBS experiment near Wake Island in 1981 that the Wake hydrophones have higher S/N ratios than OBS's by about 10 dB over the range 1-20Hz.

(14) The presentation of studies on the spectra of nuclear explosions and earthquakes, as well as spectral studies of Po/So, at the 1982 DARPA/AFOSR annual review.

(15) Preparation of a report (Po/So Phases: Propagation Velocity and Attenuation Across a 1600 km Long Deep Ocean Hydrophone Array by D. Walker and C. McCreery) which quantifies the variations in velocity and spectra of Po/So phases across a long deep ocean array.

SIGNIFICANT TASKS REMAINING

(1) Consistent with our efforts to determine the mechanism for the generation and propagation of Po/So phases, a comprehensive investigation of the relationship of the T phase to Po/So will be made. This study will include spectral studies of the entire T phase coda (i.e., forerunners as well as peak signals) and comparisons of these spectra to the spectra of Po/So phases.

(2) Differences between the hydrophone/cable response (and possibly the lithosphere response) across the Wake array will be determined and removed from the data. This will be necessary to evaluate the stability of yield estimates from spectral or waveform data across .e array. Such an evaluation will be made.

(3) Research on coherence across the Wake array will be completed witl the coming year. and the significance of these studies in terms oi possible improvements in S/N will be evaluated.

(4) S/N comparisons to the Wake hydrophones will be made with the OSS data which was retrieved from its recording package on the ocean bottom this past summer.

(5) Profiles of Po/So spectra as a function of focal depth will be made. If sufficient data is available for very shallow focus events, the possible significance of the relationships in terms of nuclear detection and/or discrimination will be evaluated.

The expanded Wake Island Hydrophone Array was successfully installed with funds provided primarily by AFOSR. However, since supplementary support of critical importance was provided by ACDA, all studies utilizing data acquired by the upgraded system should acknowledge both agencies. In the coming year ACDA funds will be used primarily on item #2 above, with the possibility that supplementary support for this task may be provided by AFOSR. On all other tasks AFOSR will be the principal supporter, with some supplementary funds provided by ACDA.

APPENDIX I

GEOPHYSICAL RESEARCH LETTERS, VOL. 10, NO. 1, PAGES 59-62, JANUARY 1983

SPECTRA OF NUCLEAR EXPLOSIONS, EARTHQUAKES, AND NOISE FROM WAKE ISLAND BOTTOM HYDROPHONES

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Abstract. Spectral characteristics of P phases from 4 shallow focus earthquakes and 8 underground explosions, and of 52 samples of ocean bottom background noise, are examined by using tape recordings of ocean bottom hydrophones near Wake Island from July 1979 through March 1981. Significant differences are found between spectra of large shallow focus earthquakes and explosions ($5.7 \leq mb \leq 6.3$) observed at 61° to 77° epicentral distance. For similar magnitudes, explosions were found to have less energy at frequencies below 1.5 Hz and more energy at frequencies above 2.0 Hz. Earthquakes were found to have a spectral slope of -28 dB/octave (relative to pressure) over the band 1 to 6 Hz. Explosions were found to have the same spectral slope over the band 2.2 to 6 Hz, but a different slope of -12 dB/octave over the band 1.1 to 2.2 Hz. High frequencies (>6 Hz) observed in the teleseismic P phases indicate high Q values for the deep mantle. Ambient noise levels on the ocean bottom near Wake are comparable to levels at the quietest continental sites for frequencies between 3 and 15 Hz. Also high levels of coherence (at least as high as 0.85) have been observed for P phases recorded on sensors with 40-km separation.

Introduction

In an earlier report (Walker, 1980), slow-speed paper recordings of hydrophones located near Wake Island were used in a study of P phases from underground nuclear explosions and earthquakes at comparable distances. That study was prompted by: (1) the work of Evernden (1977) and Evernden and Kohler (1979), which showed that P phases recorded in the 60° to 90° distance range from underground explosions were surprisingly rich in high-frequency energy (at least as high as 9 Hz); (2) the extreme sensitivity of the Wake hydrophones to high-frequency signals (Walker et al., 1978); and (3) the location of most known underground test sites in the 60° to 90° distance range from the Wake hydrophones. The major conclusion of Walker (1980) was that observable P phases were found for all Russian underground explosions with estimated yields in excess of 270 kilotons, whereas no such phases were found for earthquakes of comparable or greater magnitude at similar distances. Principal limitations of the investigation were that: (1) the slow-speed paper recordings were not suitable for detailed spectral analyses of either the recorded signals or the noise; and (2) the filtering was not optimized for the recording of distant earthquakes and explosions.

Paper number 2L1384.
0094-8276/83/ 002L-1384$3.00

This report discusses the spectra of P phases from underground explosions and earthquakes as well as the spectra of ambient noise derived from recent tape recordings of the Wake Island ocean bottom hydrophone array. This array consists of six hydrophones on relatively flat ocean bottom near Wake at about 5.5-km depth. The hydrophones are located at the vertices and center of a pentagon roughly 40 km across and are cabled directly to Wake Island. Only three of the hydrophones could be recorded simultaneously on the recording system used. This system was a four-channel (three data, one time code) slow-speed cassette recorder, with automatic gain-ranging amplifiers following low-noise preamps connected to the differential outputs (via cabling) of the moving coil hydrophones on the ocean bottom. These recorded signals were used to compute absolute spectra of the seismic phases and background noise by the following steps: (1) digitization at 80 samples per sec after anti-alias filtering; (2) normalization of the automatic gain levels; (3) computation of contiguous 512-point FFT's (6.4 sec per FFT) and their corresponding power spectra; (4) averaging of those spectra over the time window of interest; (5) normalization of the spectral bandwidth from 0.156 Hz to 1.0 Hz; and (6) removal of the hydrophone/recording system/anti-alias response. The recording system and anti-alias response were determined in situ. The hydrophone response was taken from the Columbia University OBS Calibration Manual (Thanos, 1966), which describes the estimated response between 0.05 and 100 Hz of an equivalent hydrophone. More specific information on the Wake hydrophone/cable responses at these frequencies is not available because of the age of the array (about 20 years), its formerly classified status, and the original bandwidth of interest (>10 Hz) to those who installed the array.

Spectra of Underground Explosions and Natural Earthquakes

The earthquakes and explosions investigated in this study are listed in Table 1. These events were chosen because they all occurred within 60° to 90° epicentral distance, were shallow focus, had large signal/noise ratios, and did not exceed the dynamic range of the recording system. Figure 1 shows the pressure spectra of some of these events, as well as composite pressure spectra for the earthquake and explosion groups. For purposes of comparison, pressure and vertical

Table 1. Description of Events Used in Figure 1

No.	Date	Location	Distance (degrees)	Depth (km)	Magnitude (mb)	Type	Number of Hydrophones
1	07/24/79	S. of Java	65.7	31	6.3	Earthquake	3
2	08/04/79	E. Kazakh	73.2	0	6.1	Explosion	3
3	08/18/79	E. Kazakh	73.2	0	6.1	Explosion	3
4	09/24/79	Novaya Zemlya	76.7	0	5.7	Explosion	1
5	09/29/79	N. Sumatera	72.9	27	6.2	Earthquake	1
6	10/18/79	Novaya Zemlya	76.8	0	5.8	Explosion	1
7	10/28/79	E. Kazakh	73.2	0	6.0	Explosion	1
8	12/23/79	E. Kazakh	73.3	0	6.1	Explosion	1
9	07/29/80	Nepal	76.4	18	6.1	Earthquake	2
10	09/14/80	E. Kazakh	73.2	0	6.2	Explosion	2
11	10/12/80	E. Kazakh	73.2	0	5.9	Explosion	2
12	11/19/80	Sikkim	70.4	17	6.0	Earthquake	2

displacement may be related using the expression: $P = \omega\rho v A$, where P is pressure, ω is angular frequency, ρ is seawater density, v is the speed of sound in seawater, and A is vertical

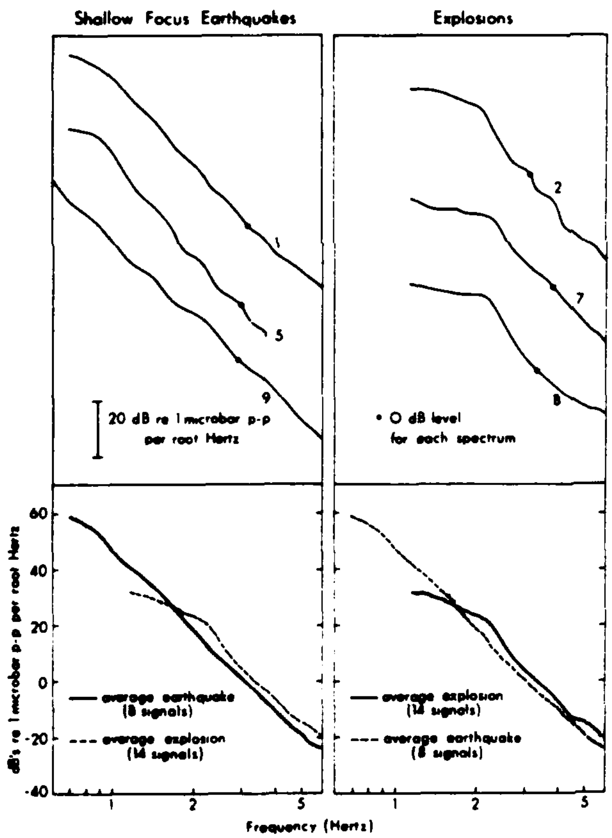

Figure 1. Sample spectra of P from some shallow focus earthquakes and nuclear explosions are shown in the upper portion of this figure. Numbers refer to the events as described in Table 1. The composite spectrum of each group, an average with ± 1 standard deviation, is shown in the lower portion of the figure. Before standard deviations were computed, individual spectrums were normalized by subtracting the difference between their mean dB value over the range 1.5-3.0 Hz and the mean dB value for all spectra over the same frequency range.

displacement. This relationship holds for compressional energy arriving vertically from below the hydrophone. The following differences in the spectral signatures between explosions and shallow focus earthquakes are evident: (1) lack of energy in explosion P relative to earthquake P at frequencies below 1.5 Hz, (2) changes in spectral slope (corner frequency?) for explosions from -12 to -28 dB/octave (equivalent to -18 and -34 dB/octave in ground displacement) at about 2.2 Hz, and (3) greater energy in explosion P relative to earthquake P at frequencies above 2.0 Hz, despite smaller magnitude of the average explosion (6.03) than that of the average earthquake (6.16). Differences between the explosion and earthquake P phases observed at these frequencies is not surprising. The high frequencies observed and the actual shape of these curves have implications regarding Q along the travel path. Although these implications will not be discussed here, it is pointed out that the observation of frequencies in excess of 6 Hz (and up to 9 Hz) at distances greater than 60° implies a high Q at least along the deep mantle part of the P travel path.

Although this study found a common high-frequency slope (-28 dB/octave) for both earthquakes and explosions, at least one other investigator (Evernden, 1977) has found earthquakes to fall off at least f^{-1} faster than explosions. This discrepancy might be explained by the small number of earthquakes used in the present study and the requirement in choosing those events of large signal/noise. Earthquakes having more high-frequency energy would have greater signal/noise because of much lower noise levels at high frequencies.

NTS events were not included in this study because they were rarely recorded with signal/noise greater than 2. Although signal levels near 1 Hz for NTS events are roughly equivalent to those observed for similar magnitude earthquakes and Soviet explosions, the signal fall-off above 1 Hz appears to be generally much greater for NTS. Therefore, little signal energy from NTS events is observed in the band above 2 Hz where lower ambient noise levels significantly enhanced the signal/noise of those events that were used. This rapid fall-off may be due to a recognized low Q effect in the source region (see for example Der et al., 1982).

Ocean Bottom Ambient Noise

The average background noise at the ocean bottom near Wake is shown in Figure 2 (labeled A). This average, along with its standard deviation, was determined from 52 samples of noise taken over 18 months of recording. Also plotted are an assortment of published noise curves for both ocean bottom and continental sites. When compared with noise levels from continental sites, the Wake ambient noise level could be described as: (1) high for frequencies between 0.2 Hz and 1.5 Hz; (2) average for frequencies between 1.5 Hz and 3.0 Hz; and (3) low for frequencies between 3.0 Hz and 15.0 Hz.

The observed low noise levels at higher frequencies affirm the ability of the Wake hydrophones to detect seismic signals at those frequencies. In addition, high-frequency phases recorded on the deep ocean bottom, which traverse only a few kilometers of homogeneous crust, may be less distorted than similar phases recorded on continents, which often traverse more than 40 km of crust. Consequently, coherence across the

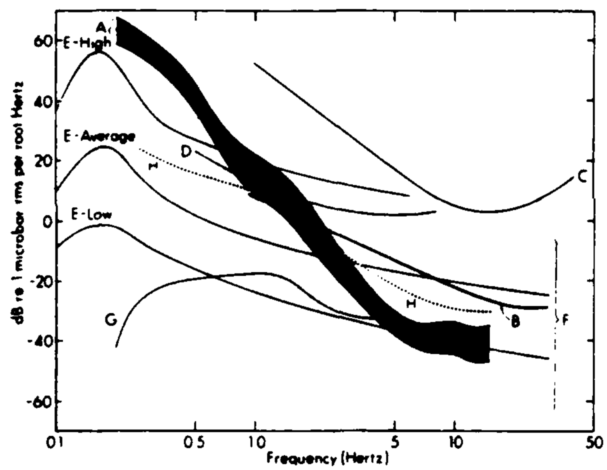

Figure 2. The average spectrum ± 1 standard deviation of 52 samples of background noise over 18 months from the Wake bottom hydrophones is labeled A. Also shown are some published noise curves for both ocean-bottom (B, C, D, and H) and continental (E, F, and G) environments, which have been converted from an assortment of units to the scale shown. B is a hypothetical "sample spectrum of deep-sea noise" (Urick, 1975; p. 188). C is a vertical seismometer measurement made in the Mariana Basin (Asada and Shimamura, 1976). D is a vertical seismometer measurement made at 46-km depth between Hawaii and California (Bradner and Dodds, 1964). H is a noise curve for a hydrophone bottomed off Eleuthera Island at 1200-m depth (Nichols, 1981). E represents low, average, and high noise levels estimated from curves compiled by Brune and Oliver (1959). F is an area bounded by the limits of noise curves measured on vertical seismometers for 16 locations within the United States and Germany (Frantti et al., 1962). G is the noise curve for the Oyer subarray of the Norwegian seismic array measured during a period "when most of the North Atlantic Ocean was very quiet" (Bungum et al., 1971).

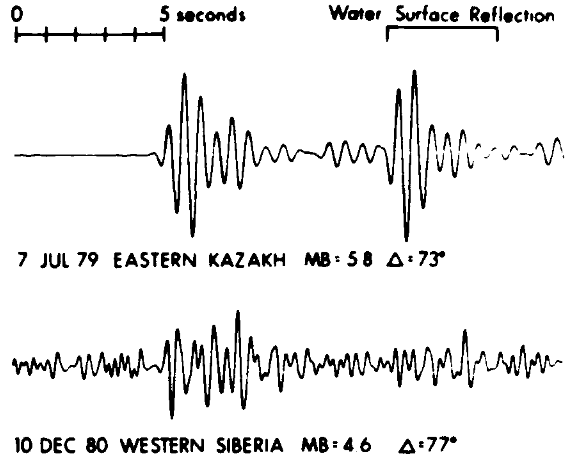

Figure 3. Sample time series of P, filtered to maximize signal/noise, from two nuclear explosions recorded on the Wake bottom hydrophones. The upper trace is from a single hydrophone and shows the direct arrival and its first water surface reflection. The lower trace is a composite of signals from two hydrophones with 40-km separation, obtained as follows: the filtered (1.5-5.0 Hz) time series from each hydrophone was inverted, shifted in time by the water surface reflection time, weighted to maximize the increase in signal/noise, and added to itself; the two resulting time series were then added with the appropriate propagation delay, and weighted to maximize the increase in signal/noise. Signal/noise was increased by 90% of the theoretical maximum with this method, indicating a high level of coherence between the signals added.

array appears to be high for telesiesmic P. These factors (low noise levels and a thin, homogeneous crust) have enabled the Wake array to acquire some impressive recordings of underground nuclear explosions. Shown in Figure 3 is an Eastern Kazakh explosion at 73° with a body wave magnitude of 5.9. Its signal/noise ratio is approximately 50/1. Also shown in Figure 3 is a Western Siberian explosion at 77° with a body wave magnitude of 4.6. This arrival is the weighted sum of signals from two of the hydrophones, as explained in the figure caption. Coherence between the two hydrophone signals in the band 1.5 to 5 Hz was measured at 0.85 for this arrival.

Summary

Significant differences are found between the spectra of P phases from explosions and from shallow focus earthquakes at 61° to 77° epicentral distance. Explosion spectra exhibit a change in spectral slope at about 2.2 Hz from -12 to -28 dB/octave relative to pressure. Earthquake spectra have a nearly constant slope of -28 dB/octave over the range of 1 to 6 Hz. High frequencies (>6 Hz) observed in these phases indicate a high Q in the deep mantle.

The ambient noise spectrum on the ocean bottom near Wake falls off at about -24 dB/octave over the range of 0.3 to 6 Hz. Between 3 and 15 Hz

the background noise levels are comparable to those at the quietest continental sites. Teleseismic P has been observed with a high level of coherence across a sensor separation of 40 km. The low level of ambient noise on the ocean floor at high frequencies and the high levels of coherence observed indicate that the ocean bottom may be an excellent observational regime for teleseismic P as well as other seismic phases rich in high frequencies.

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APPENDIX II

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SPECTRAL CHARACTERISTICS OF HIGH-FREQUENCY P_N, S_N PHASES IN THE WESTERN PACIFIC

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Abstract. Pn and Sn phases from 25 selected earthquakes recorded since July of 1979 on ocean bottom hydrophones near Wake Island are used to complement and extend prior investigations of high-frequency Pn, Sn spectra in the Western Pacific. At a distance of about 18° (≈ 2000 km), frequencies for Pn and Sn are as high as 30 and 35 Hz, respectively; at a distance of about 30° (≈3300 km), as high as 15 and 20 Hz, respectively. Pn phases lose their high-frequency energy more rapidly than Sn phases do, yet Pn wavetrains are much longer than Sn wavetrains. Pn wavetrains of longer duration, more energy, and higher frequencies are found for travel paths primarily in the Northwestern Pacific Basin than for travel paths across the transition zone from the shallow Ontong-Java Plateau to the deep Northwestern Pacific Basin. Sn phases are extremely weak or absent for travel paths crossing this transition zone from the shallower Ontong-Java Plateau to the deeper Northwestern Pacific Basin, whereas Sn phases are well recorded for travel paths crossing the transition zone in the opposite direction. Although normal, mantle-refracted P phases are well recorded beyond about 21° (≈2300 km), available data indicate that detectable normal, mantle-refracted P phases may not exist at distances from about 17° to 21°.

Introduction

Recent investigations of high-frequency Pn, Sn in the Pacific [Walker, 1977; Walker et al., 1978; Sutton et al., 1978; Talandier and Bouchon, 1979; and McCreery, 1981] suggest that the real character of these phases is revealed at frequencies much higher than those traditionally associated with normal, mantle-refracted body waves at teleseismic distances (i.e., ≈ 1 Hz). For example, in one investigation [Walker et al., 1978], frequencies as high as 12 and 15 Hz were found for the Pn and Sn phases, respectively, of an earthquake recorded at a distance of 28.3° (3147 km).

In this report we offer a more comprehensive analysis of the spectral characteristics of Pn, Sn using additional data recorded since July of 1979 on ocean bottom hydrophones near Wake Island. Only undistorted arrivals with signal/noise ratios of at least 3/1 were used in this investigation. Epicentral distances, origin times, depths, and magnitudes are given in Table 1; and locations of epicenters are shown in Figure 1.

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Northwestern Pacific Basin Travel Paths

Spectrograms for some of the Pn, Sn phases having travel paths primarily under the deep Northwestern Pacific Basin (i.e., events 1 through 18) are shown in Figure 2. All reveal high frequencies, with values in excess of 20 Hz for both Pn and Sn at a distance of 18.0° (2000 km; event 2) and values of up to 15 and 20 Hz for Pn and Sn, respectively, at a distance of 29.4° (3270 km; event 17). (More detailed spectral analyses of the phases for event 2 at 18.0° indicate values as high as 30 and 35 Hz for Pn and Sn, respectively.)

Spectrograms for events 17 and 18 show the normal, mantle-refracted P phases as well as high-frequency Pn and Sn phases. Other events for which normal, mantle-refracted P phases have been clearly recorded are 11, 12, 13, 15, and 16. The fact that all of these events are at distances in excess of 21° is not coincidental, for it is only at these distances (the precise crossover depending, in part, on focal depth) that P phases begin to arrive ahead of the high-frequency Pn phase (Figure 3). With increasingly shorter distances, high-frequency Pn arrives increasingly ahead of the expected P.

Although it might seem reasonable to assume that P does arrive at distances less than about 21°, but is masked by Pn, such an assumption should be tested. One test is to compare spectrums where all of the P's energy, or large portions of it, might be suspected of being present within the Pn coda (i.e., events 1 through 10) to the spectrums where only Pn is known to exist (i.e., events 13 through 18; 11 and 12 could not be used due to Pn clipping). Composite spectrums have been made for the two groups of Pn arrivals (i.e., Pn with P suspected, at distances from about 17° to 22°; and Pn with P known to be absent, at distances from about 26° to 33°), as well as for all P phases, at distances from about 22° to 33°, either clearly arriving well ahead of Pn (events 11, 12, 13, 15, 16, 17, and 18) or suspected of arriving close to, but ahead of, Pn (events 9 and 10). These composites and the individual absolute spectrums from which they were derived are shown in Figure 4.

Individual and composite P spectrums are obviously, and not unexpectedly, very different in character from individual and composite Pn

TABLE 1. Epicentral Distances, Origin Times, Depths, and Magnitudes of Events 1-25 in Figure 1

Event Number	Distance, deg.	Date	Time	Depth, km	Magnitude, mb
1	17.8	July 8, 1980	1704:15.1	54	4.8
2	18.0	July 11, 1980	0942:00.2	33	5.3
3	18.7	June 9, 1980	1923:33.3	33	5.6
4	19.0	Dec. 8, 1979	1258:55.2	51	5.5
5	19.8	Dec. 16, 1979	1050:48.0	96	5.0
6	20.1	March 26, 1980	0722:37.0	45	5.5
7	20.7	Nov. 1, 1980	0440:37.7	109	5.6
8	20.9	Dec. 17, 1979	0728:48.2	33	5.1
9	21.2	Jan. 15, 1980	0523:25.7	120	5.1
10	21.7	Nov. 29, 1979	1708:21.3	109	5.4
11	24.9	Dec. 11, 1979	1726:22.1	161	5.9
12	25.4	Dec. 19, 1980	2332:41.6	79	6.2
13	26.5	Oct. 20, 1980	0329:21.3	81	5.5
14	27.1	Oct. 28, 1979	0539:36.0	88	5.4
15	28.5	Feb. 23, 1980	0551:03.5	47	6.4
16	28.5	Jan. 1, 1981	1032:13.1	53	6.2
17	29.4	Nov. 26, 1980	2348:59.9	77	5.8
18	32.7	Aug. 22, 1979	1828:55.7	128	5.5
19	28.0	Feb. 12, 1980	0320:23.2	75	5.9
20	28.0	Aug. 13, 1979	0303:47.9	88	5.8
21	28.6	May 14, 1980	1126:00.6	57	6.1
22	28.8	Sept. 28, 1980	1825:59.7	68	6.0
23	30.4	Nov. 6, 1979	1138:31.5	30	6.0
24	31.1	Oct. 23, 1979	0951:06.7	22	6.1
25	31.1	Feb. 22, 1980	2115:42.1	68	5.9

spectrums, in that the P has larger signal-to-noise ratios at lower frequencies (i.e., 1-2 Hz) than either Pn grouping (Figures 4 and 5), and the composite P is richer in lows, and weaker in highs, relative to the 26° to 33° Pn composite (Figure 5a). In comparing the composite 17° to 22° Pn spectrum to the composite 26° to 33° Pn spectrum (Figure 5b), we note that the 17° to 22° Pn is similar in character to the 26° to 33° Pn for frequencies higher than 2 Hz, but has lower signal-to-noise ratios at frequencies less than 2 Hz (i.e., values fall below the "4 dB above noise" requirement for plotting). This latter observation is also apparent in the individual spectrums (Figure 4). The fact that values for the 17° to 22° Pn spectrum fall below the 4 dB requirement for frequencies less that 2 Hz, coupled with values for the 22° to 33° P spectrum above the 4 dB level at those frequencies, suggests that detectable normal, mantle refracted P phases may not exist in the Pn codas of events at distances of 17° to 22°.

Another important, though not surprising, observation to be made from the composite plots (Figure 5b) is that Pn phases at great distances appear to be weaker at higher frequencies ($\gtrsim$10 Hz) than Pn phases at shorter distances.

Sn composite plots have also been made for the same events for which Pn composites have been made. These plots are shown in Figure 6. Although normal mantle-refracted P phases have been well recorded at great distances, normal mantle-refracted S phases from earthquakes have not been recorded by the Wake hydrophones. Presumably, this is due to the small pressure signal in the water resulting from S phases at

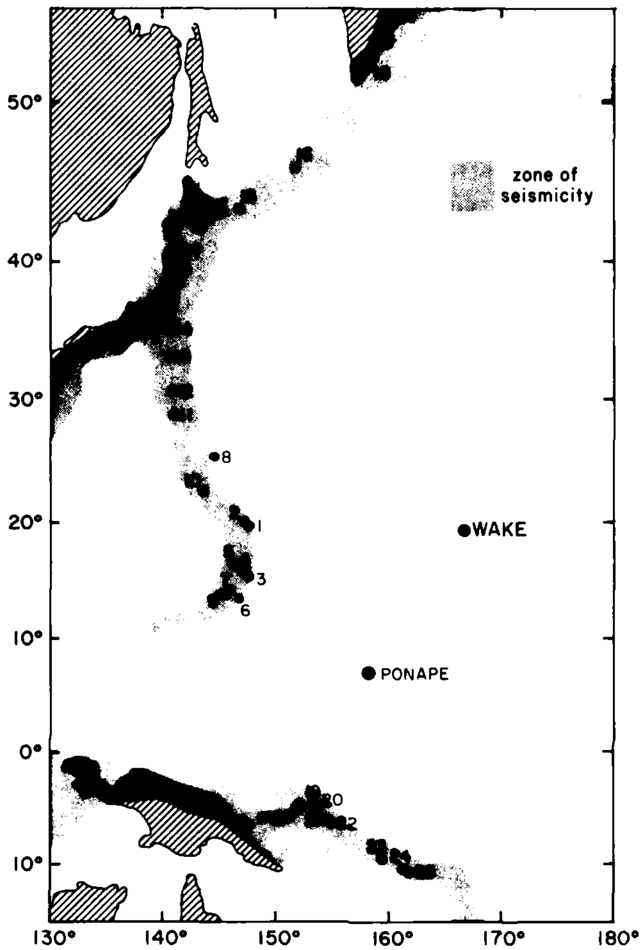

Fig. 1. Epicenter location map.

teleseismic distances. In addition, background noise levels are higher for those frequencies at which S would appear [McCreery et al., 1982].

In Figure 6a, Sn composite plots for the 17° to 22° and 26° to 33° distance ranges are compared to one another. Considering that the standard deviations of all of the composite plots presented in this paper are generally in the range of ± 3 dB, no significant differences are apparent in Figure 6a. In Figures 6b and 6c, Sn composite plots are compared to their respective Pn composite plots. Again, no statistically significant differences are indicated. In other words, Sn signal strength is generally comparable to Pn signal strength. This similarity of Pn and Sn spectrums was observed earlier for travel paths in the Western Pacific east of the Marianas [Ouchi, 1981].

Special mention should be made of the fact that the composite Sn plot in Figure 6c is 4 dB above background noise at frequencies well above 8 Hz while the composite Pn plot is not. Also it should again be noted that the individual Pn's and Sn's used to formulate the composite plots were for the same earthquakes. These considerations suggest that Sn phases do not lose their high frequencies as rapidly as Pn phases.

It has been pointed out that some high frequencies observed elsewhere might be the result of instrumental nonlinearities [Sacks, 1980] and/or nonlinear seismic interactions in the vicinity of a receiving station [Nakamura and Koyama, 1982]. As the lower frequencies are of comparable amplitude for both Pn and Sn at both distance ranges considered (Figures 6b and 6c), it is unlikely that such nonlinearities could explain the data discussed here. We also note that P, which has higher average amplitudes than

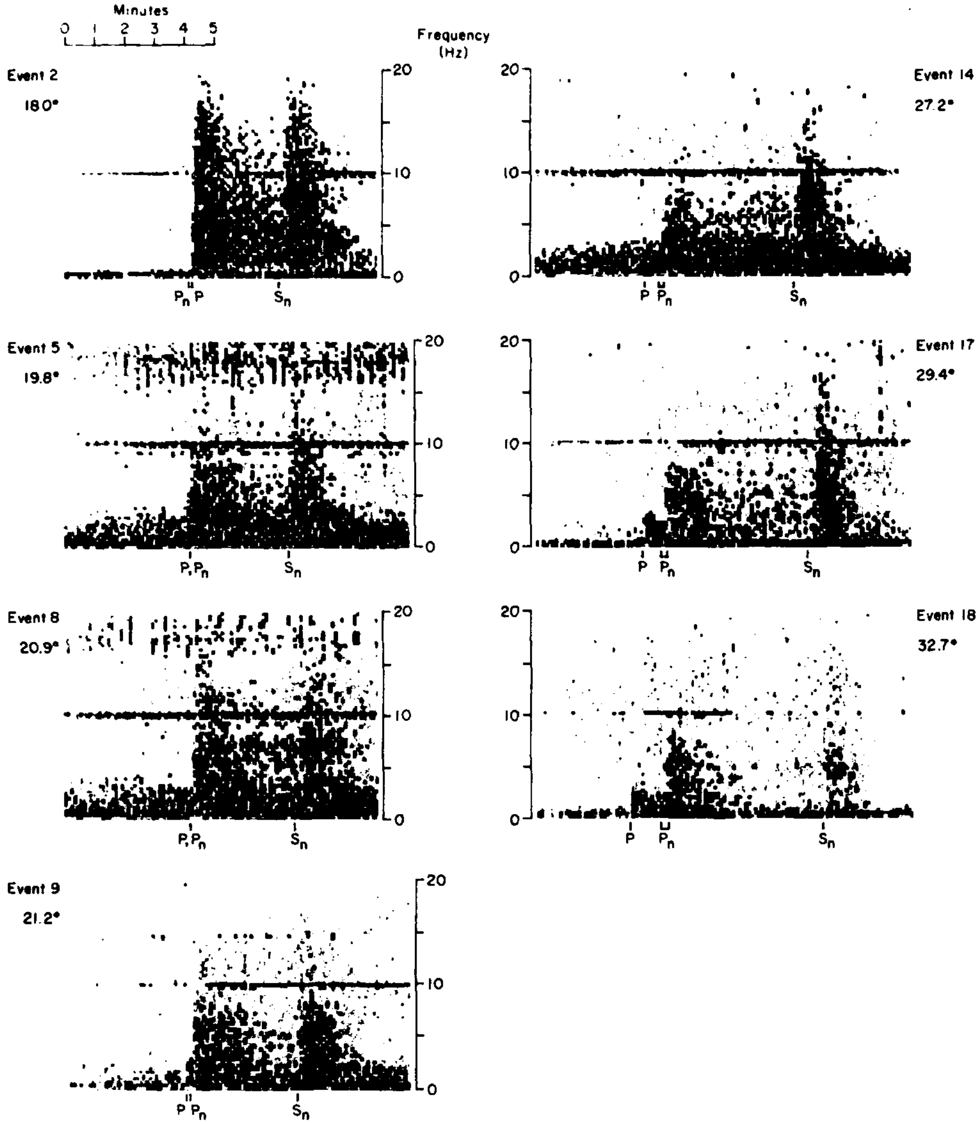

Fig. 2. Spectrograms for some earthquakes having travel paths to Wake under the Northwestern Pacific Basin. Expected times of arrivals are based on either the Jeffreys and Bullen [1958] tables for P or Pn/Sn travel time curves from Walker [1977]. These and succeeding spectrograms were made by dividing the time series into adjacent 512-point segments, Lanczos squared windowing the segments, and performing a fast Fourier transform (FFT) on each segment. In the horizontal direction, the width of each shaded block corresponds to one of the 512-point segments in the time series. In the vertical direction, each block is the average of two adjacent power spectral estimates out of the FFT. Only frequencies from 0 to 1/2 Nyquist are shown. The contour interval is 8 dB. The line at 10 Hz is due to time code cross talk. Instrument responses have not been removed.

Pn or Sn at the lower frequencies, has the most rapid falloff toward higher frequencies (Figure 5).

In all of these comparisons, another objection that could be made is that differences in source spectrums (and/or orientation of the source relative to the recording station) were not considered. Although all of the events occurred within the subducting margin of the Northwestern Pacific and the Pn, Sn phases used were generated by earthquakes having focal depths of 128 km or less, differences in source spectrums might be

significant. We believe, however, that overall trends of the individual spectrums (Figure 4) used for the composite plots are similar (as opposed to specific details that may differ) and that such similarities could justify the general conclusions drawn from that data. We also note that source effects are minimized in those comparisons of composite Pn's and Sn's from the same earthquakes (Figures 6b and 6c).

Another interesting feature of Pn, Sn phases is that the Pn wavetrain is much longer than the Sn wavetrain (Figure 2). Spectral analyses indicate that energy is lost at all frequencies in the later arriving portions of these wavetrains, and that this loss is much greater in the Sn wavetrains than in the Pn wavetrains.

Ontong-Java Plateau Travel Paths

Spectrograms for some of the more interesting Pn phases with travel paths to Wake under the shallow Ontong-Java Plateau (as well as portions of the deep Northwestern Pacific Basin) are shown in Figure 7. (Refer also to Table 1, Figure 1, and Figure 8.) The most conspicuous feature of these spectrograms is that Sn phases are extremely weak, or absent, even though Pn phases are prominent.

Figure 9 compares the composite Pn spectrum for events having Ontong-Java Plateau travel paths (events 19 through 25) to the composite Pn spectrum for events at comparable distances having Northwestern Pacific Basin travel paths (events 15 through 18). The Northwestern Pacific Basin events appear to have more Pn energy at higher frequencies than the Ontong-Java Plateau events. However, because of the approximate ± 3 dB standard deviation on each of these curves, this suggestion is not statistically significant. Comparing Figures 2 and 7, the duration of the Pn

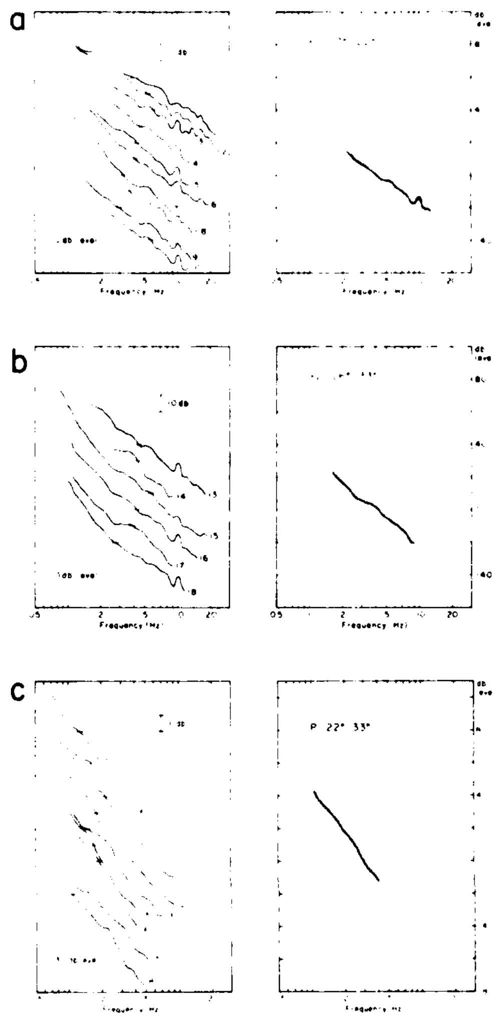

Fig. 4. Individual and composite spectrums for arrivals at Wake where (a) both Pn and P might be suspected of being present, at distances from about 17° to 22°, (b) only Pn is known to exist at distances from about 26° to 33°, and (c) only P is known to exist, at distances from about 22° to 33°. The spectrums are power level spectrums in decibels relative to one microbar peak-to-peak pressure per root hertz. Values for individual spectrums were plotted only if they were at least 4 dB above background noise. The composite curves are simply the averages for the individual curves, with the condition that composite values were used for those frequencies lacking at most only one individual curve. Standard deviations of composite values are indicated by shading. Values for standard deviations in these and succeeding spectrums are generally in the range of ± 3 dB. The peaks at 10 Hz are due to time code cross talk.

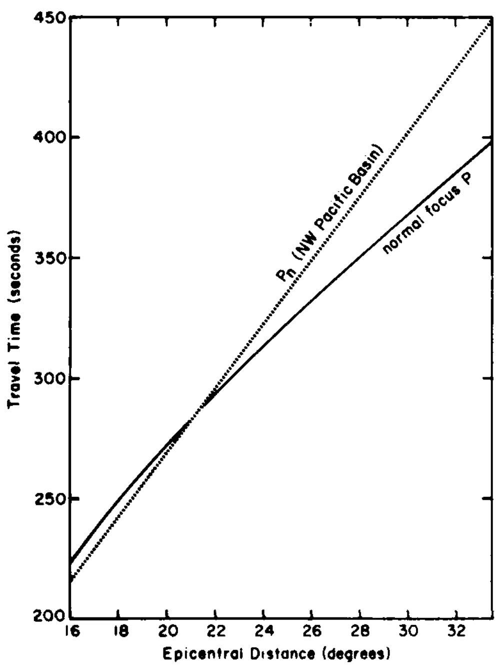

Fig. 3. Travel time curves for normal, mantle-refracted P phases and for Pn phases. P times are taken from Jeffreys and Bullen [1958], and Pn times are taken from Walker [1977].

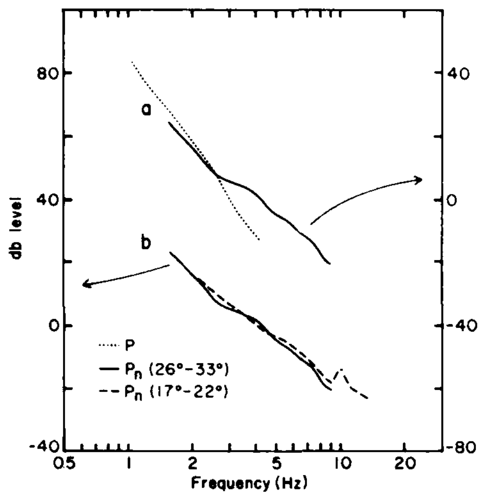

Fig. 5. Comparisons of composite spectrums: (a) P and the 26° to 33° Pn, and (b) the 17° to 22° Pn and the 26° to 33° Pn. Conclusions which can be drawn from these plots are (1) P and Pn spectrums are very different in character, (2) detectable P phases may not exist in the Pn codas of events at distances of 17° to 22°, and (3) Pn phases at great distances appear to be weaker at higher frequencies (≈10 Hz) than Pn phases at shorter distances.

wavetrains appears to be greater for the Northwestern Pacific Basin events.

In such comparisons, the important question again arises of differences in source characteristics, in this instance for New Ireland-Solomon Island earthquakes and for Japan-Kuril Islands-Kamchatka earthquakes. It is not possible, however, to attribute the absence of Sn to differences in source characteristics, as Sn phases from New Ireland and the Solomons have been well recorded at Ponape on the northern margin of the Ontong-Java Plateau [Walker, 1977]. Examples of such phases are shown in Figure 10. Of the more than forty events from the New Ireland-Solomon Islands area recorded at Ponape, amplitudes of Sn phases are at least comparable to, and frequently larger than, those of their respective Pn phases.

The absence of Sn at Wake would, therefore, appear to be a result of Sn's inability to propagate efficiently across the transition zone from the shallower Ontong-Java Plateau to the deeper Northwestern Pacific Basin, and would suggest that much of the energy in Sn travels through portions of the lithosphere involved in the transition. On the other hand, Sn's that have crossed this transition zone from the other direction (i.e., from earthquakes in the Marianas, Japan, the Kuriles, and Kamchatka) are well recorded at Ponape (Figure 10). Differences in the crustal structure of the Ontong-Java Plateau and the Northwestern Pacific Basin are indicated by the section profile [Hussong et al., 1979] shown in Figure 11.

Another comparison of spectrums at Wake for the two differing types of travel paths (Northwestern Pacific Basin and Ontong-Java Plateau travel paths) was made for the later arriving energy in the Pn wavetrains. For these comparisons, less energy at higher frequencies was present in those Pn's having travel paths that include the Ontong-Java Plateau. These deficiencies and the corresponding absence of Sn for paths across the transition zone from the shallow Ontong-Java Plateau to the deep Northwestern Pacific Basin suggest that the longer, stronger Pn phases observed for travel paths to Wake, primarily across the Northwestern Pacific Basin, may be the result of more efficient conversions of Pn to Sn (or Sn to Pn).

Concluding Remarks

The phenomenon of high-frequency Pn, Sn propagation is emerging as a major unresolved property of the oceanic crust and/or mantle. Others have described high-frequency Pn, Sn propagation as 'a challenge remaining to the theoretician' [Richards, 1979] and as 'the challenge to both explosion and earthquake

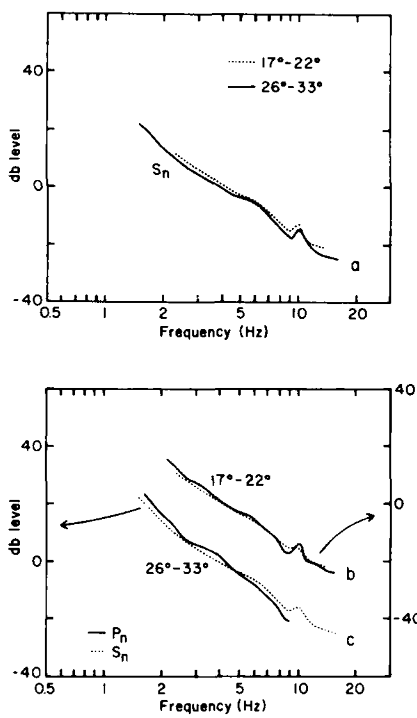

Fig. 6. Composite spectrums of Sn phases for those earthquakes with their Pn phases plotted in Figures 4a and 4b. Comparisons of spectrums are made (a) for the two Sn composites to one another, (b and c) and for each of the Sn composites to their respective Pn composite. A conclusion which can be drawn from these plots is that Sn signal strength is generally comparable to Pn signal strength except at high frequencies and large distances where Sn phases do not lose their energy as rapidly as Pn phases.

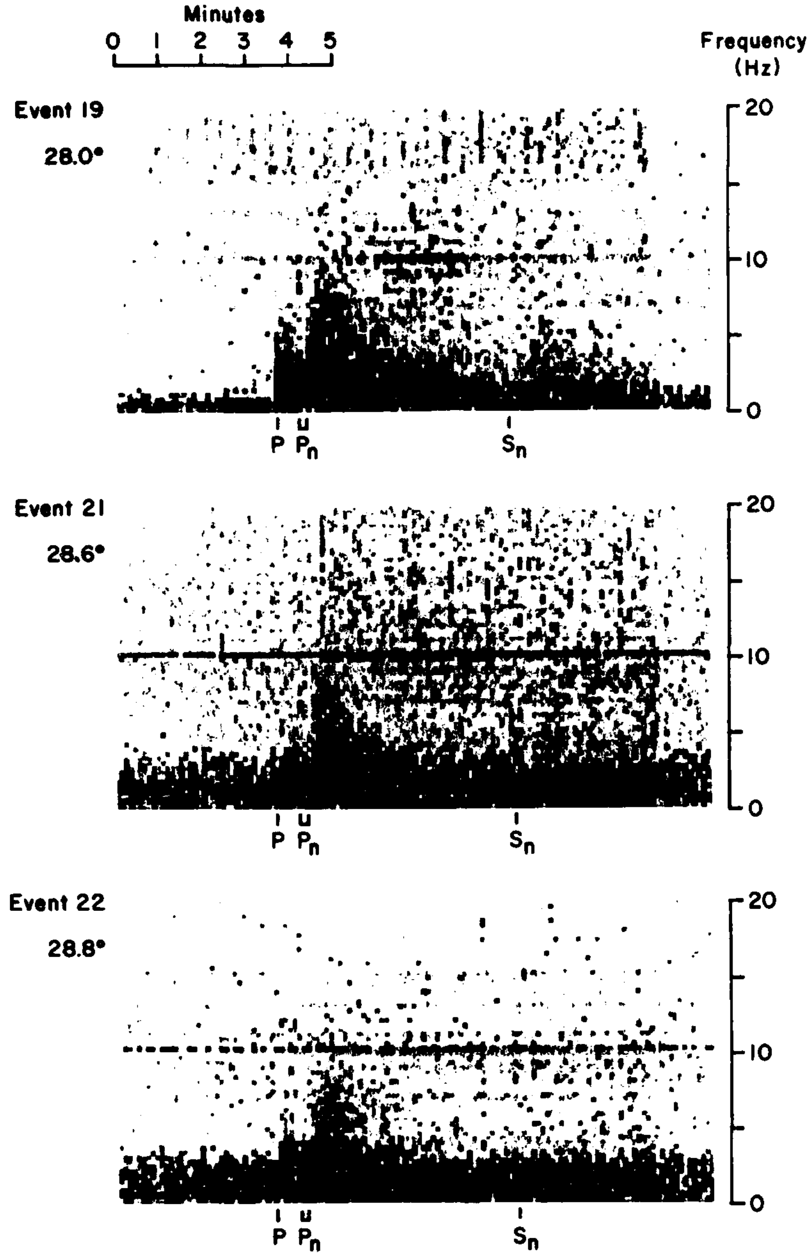

Fig. 7. Some spectrograms for earthquakes having portions of their travel paths to Wake under the Ontong-Java Plateau. In comparing these spectrograms to those of Figure 2, note the absence, or weakness, of Sn. Computational procedures are the same as used in Figure 2.

seismology for the coming decade' [Hirn et al., 1973]. These descriptions are supported not only by the unusual character of the phases but also by their probable occurrence throughout the world's oceans.

As important as recent efforts are to determine the mechanism of high-frequency Pn, Sn propagation [e.g., Stephens and Isacks, 1977; Menke and Richards, 1980; Sutton and Harvey, 1981; Gettrust and Frazer, 1981], we believe that many essential characteristics of Pn, Sn phases (especially at very high frequencies) are not well known, and that accurate quantification of those characteristics through the acquisition of additional high-quality data is greatly needed. We hope that this report will further familiarize seismologists with high-frequency Pn, Sn propagation and will be viewed as a preliminary attempt to quantify, in a relative sense, some of the essential characteristics of these phases.

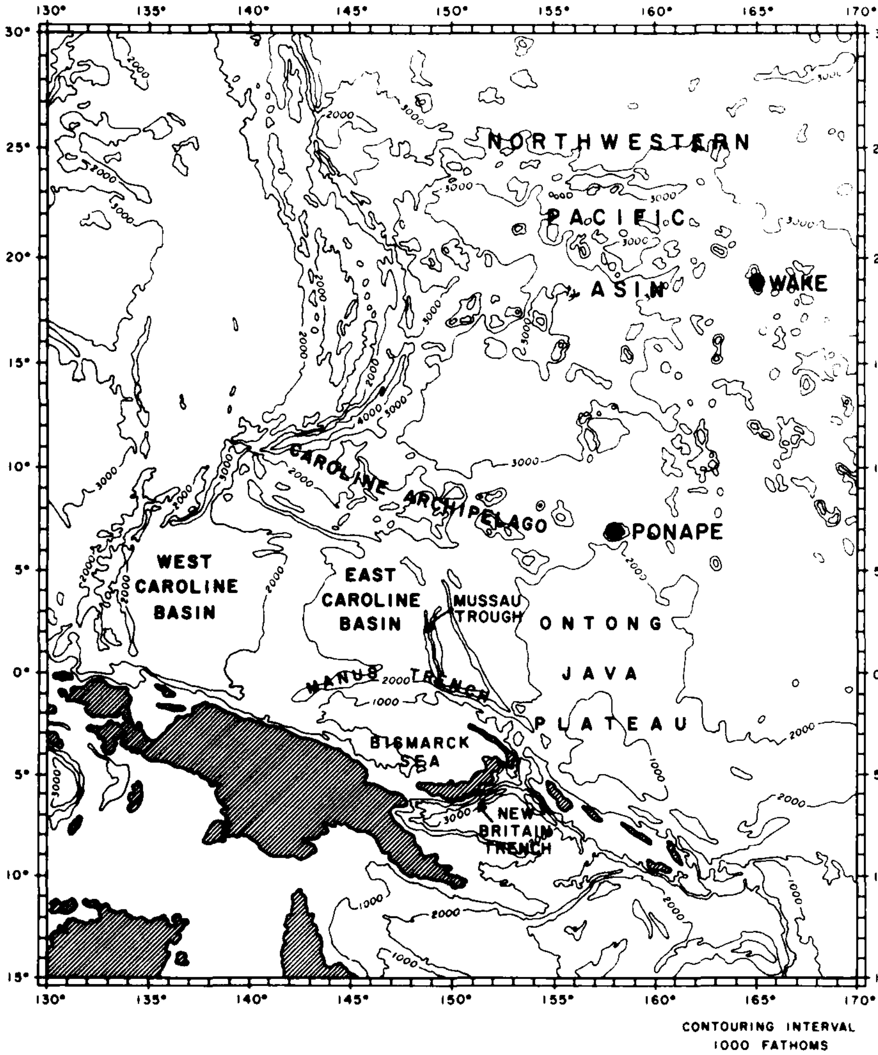

Fig. 8. Bathymetry map of the Northwestern Pacific area.

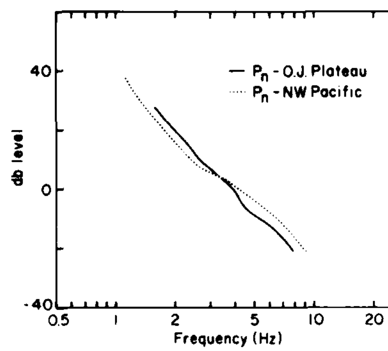

Fig. 9. Comparisons of composite Pn spectrums for events having travel paths across the Ontong-Java Plateau and the Northwestern Pacific Basin.

summary of principal observations contained in this report follows.

The apparent absence of normal, mantle-refracted P phases at distances less than about 21° (≈2300 km).

Frequencies as high as 30 and 35 Hz for Pn and Sn, respectively, at 18.0° (2000 km)

Frequencies as high as 15 and 20 Hz for Pn and Sn, respectively, at 29.4° (3270 km).

With increasing distance (i.e., from about 20° to 30°), Sn phases not losing their high frequencies as rapidly as Pn phases do.

Pn wavetrains longer than Sn wavetrains.

The extreme weakness or absence of Sn phases for travel paths across the transition zone from the Ontong-Java Plateau to the Northwestern Pacific Basin and the presence of Sn phases for travel paths in the opposite direction across this transition zone.

Longer, more energetic Pn wavetrains for travel paths primarily in the Northwestern Pacific Basin than for travel paths across the transition zone from the Ontong-Java Plateau to the Northwestern Pacific Basin.

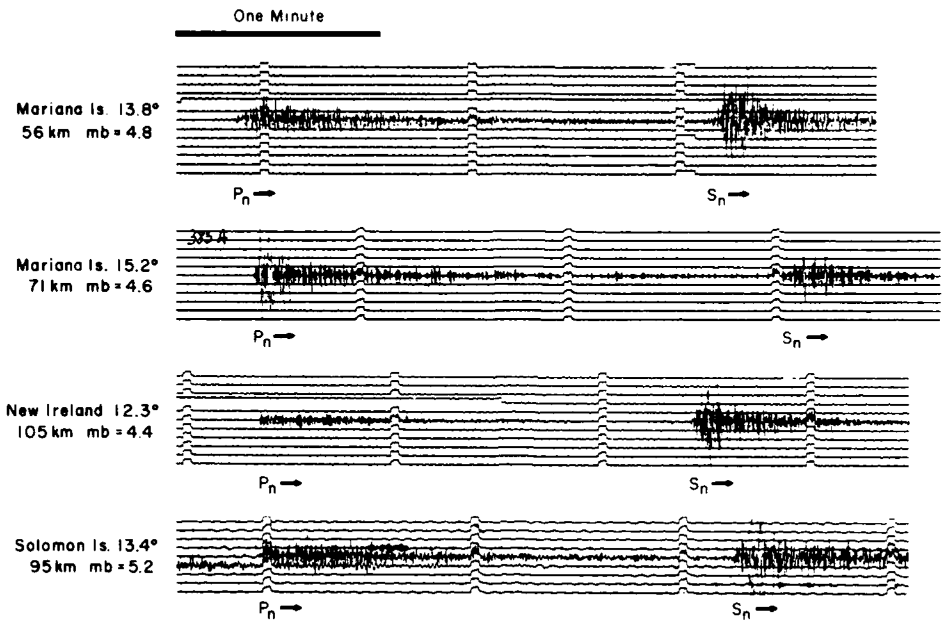

Fig. 10. Pn and Sn phases recorded at Ponape on the northern margin of the Ontong-Java Plateau.

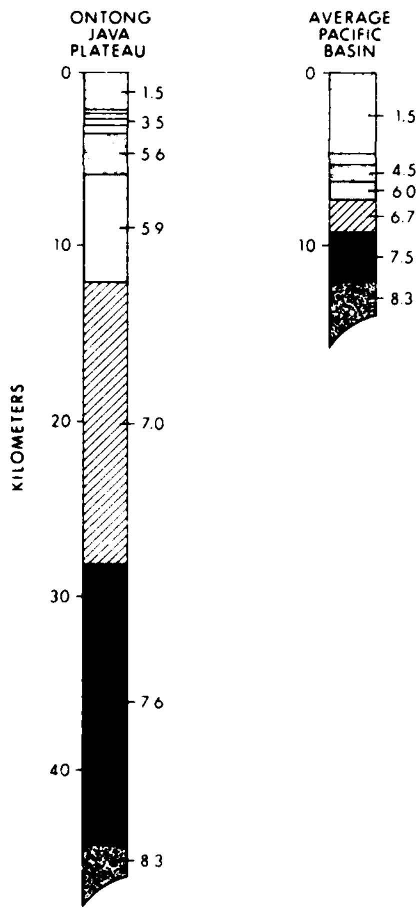

Fig. 11. Section profiles for the Ontong-Java Plateau and Pacific Basin as taken from Hussong et al. [1979].

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APPENDIX III

HIG-82-6

OCEANIC PN/SN PHASES:
A QUALITATIVE EXPLANATION
AND REINTERPRETATION
OF THE T-PHASE

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ABSTRACT

The combined effects of: (1) differing efficiencies between Pn and Sn energy transmission across the basement-sediment interface; (2) ocean surface reflections; (3) Pn to Sn conversions; and, (4) large lateral variations in the crust and upper mantle are used to formulate a working hypothesis which appears to explain, qualitatively, many observations of high-frequency Pn/Sn phases throughout the western, northern, and central Pacific. Also, the concept of Pn/Sn phases as sources of energy at the basement-sediment interface is suggested as a possible mechanism for T-phase generation through scattering or Stoneley wave generation.

CONTENTS

FIGURES

INTRODUCTION

High-frequency Pn/Sn phases were first observed nearly fifty years ago for travel paths in the Atlantic from the West Indies to the northern east coast of the United States (Leet et al., 1951, reported that these observations were made as early as 1935). The history of research on these phases since that time has been given by several authors, with some of the more recent being Molnar and Oliver (1969) and Walker (1977a).

My interest in the phenomenon began in 1963 with the recording of long-range, high-frequency Pn/Sn phases on hydrophones of what was then known as the Pacific Missile Range facility. My efforts at trying to understand these unusual phases (Sn wavetrains greater than Pn wavetrains with frequencies as high as 15 Hz at distances in excess of 3000 km; Walker et al., 1978) has continued since those initial observations. A reasonable, concise summary of my accomplishments prior to this report might be that no answers were found--only more questions. Such methodology can only be rationally tolerated for a length of time much shorter than my tenure on the case. So, for the past few years, it has been hoped that a working hypothesis could be found that would permit many, if not all, of the diverse observational pieces to be fitted together in at least a qualitative sense. Such a hypothesis could then serve as an appropriate starting point for comprehensive and detailed quantitative analyses leading to a generally acceptable model for the generation and propagation of long-range, high-frequency Pn/Sn phases. A working hypothesis has now emerged and is the subject of this report.

SN SIGNAL STRENGTH

One of the most interesting aspects of long-range, high-frequency Pn/Sn propagation in the northwestern Pacific is the strength of the Sn phase (Walker et al., in press). Relative to Pn, Sn often appears stronger at great distances--even at high frequencies (Fig. 1). A possible explanation for these observations begins with considerations of: (1) the efficiencies of Pn/Sn energy transmission across the basement-unconsolidated sediment interface; (2) possible conversions of Pn and Sn at the basement-sediment interface; and, (3) ocean-surface reflections. Observations of conversions upward and across the basement-sediment interface, as well as ocean-surface reflections for short travel paths

off the coast of California are reported in Auld *et al*. (1969), where data indicate that the percentage of P (perhaps actually Pn) energy converted to S is greater than the percentage of S (perhaps actually Sn) energy converted to P. Examples of ocean-surface reflections are also given in Shimamura *et al*. (1975) and McCreery *et al*. (in press).

The very recording of "Pn/Sn" phases on ocean-bottom sediments is evidence that Pn and Sn energy does propagate, by some means, into the sediments. Energy losses above the basement-sediment interface will occur, i.e. not all of the energy passing into the sediments will be returned to the interface by way of reflections from the ocean surface. These losses could be much greater than those produced within that portion of the waveguide below the basement-sediment interface. Furthermore, if the percentage of Sn energy lost after propagation up through the basement-sediment interface, as S or converted P or both, is less than the percentage of Pn energy similarly lost up through this interface, then Sn would retain a greater percentage of its initial energy within that portion of the waveguide below the basement-sediment interface.

Under these assumptions Sn signal strength could increase with distance relative to Pn signal strength--even at high frequencies.

PN WAVETRAINS

In spite of Sn's greater signal strength, its wavetrain is considerably shorter than Pn's (Figs. 1 and 2). This seemingly peculiar observation can be explained by considering other types of conversions.

Any phases, originally Pn or Sn, that pass upward through the basement-sediment interface may eventually be reflected by the ocean surface (or the sediment-water interface) and returned to the basement-sediment interface to continue, somewhat weakened, in the waveguide as Pn or Sn or both. Throughout the travel path to the station, original Pn's returning to the interface and continuing in part as Sn's, as well as original Sn's returning to the interface and continuing in part as Pn's, would arrive between the main Pn and Sn phases. The net effect of such conversions would be Pn wavetrains greater in their duration than Sn wavetrains.

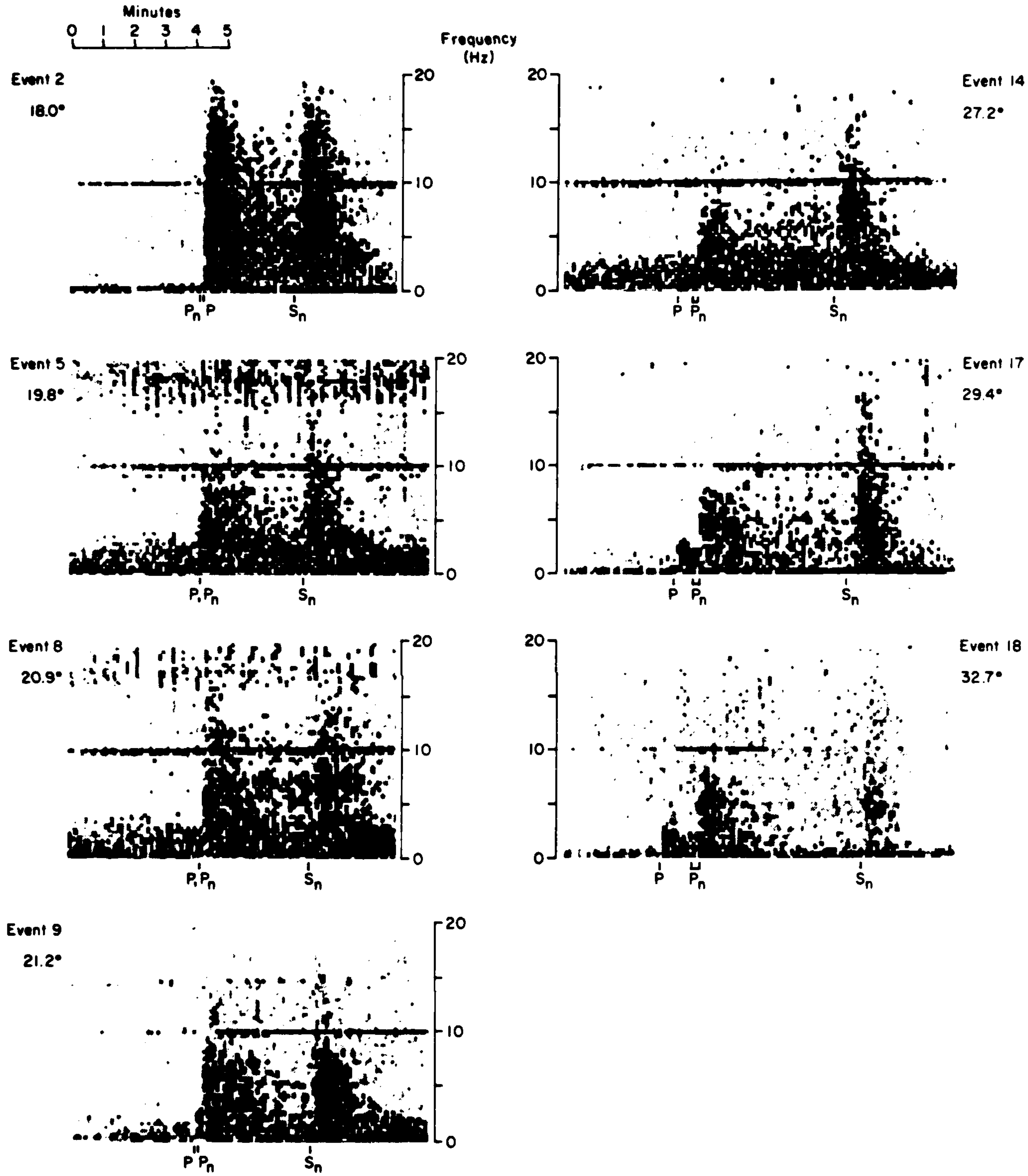

Fig. 1. Spectrograms for some earthquakes having travel paths to Wake under the Northwestern Pacific Basin. Expected times of arrivals are based on either the Jeffreys-Bullen tables (1958) for P or Pn/Sn travel time curves from Walker (1977a). The contour interval is 8 db. The line at 10 Hz is due to time code cross talk.

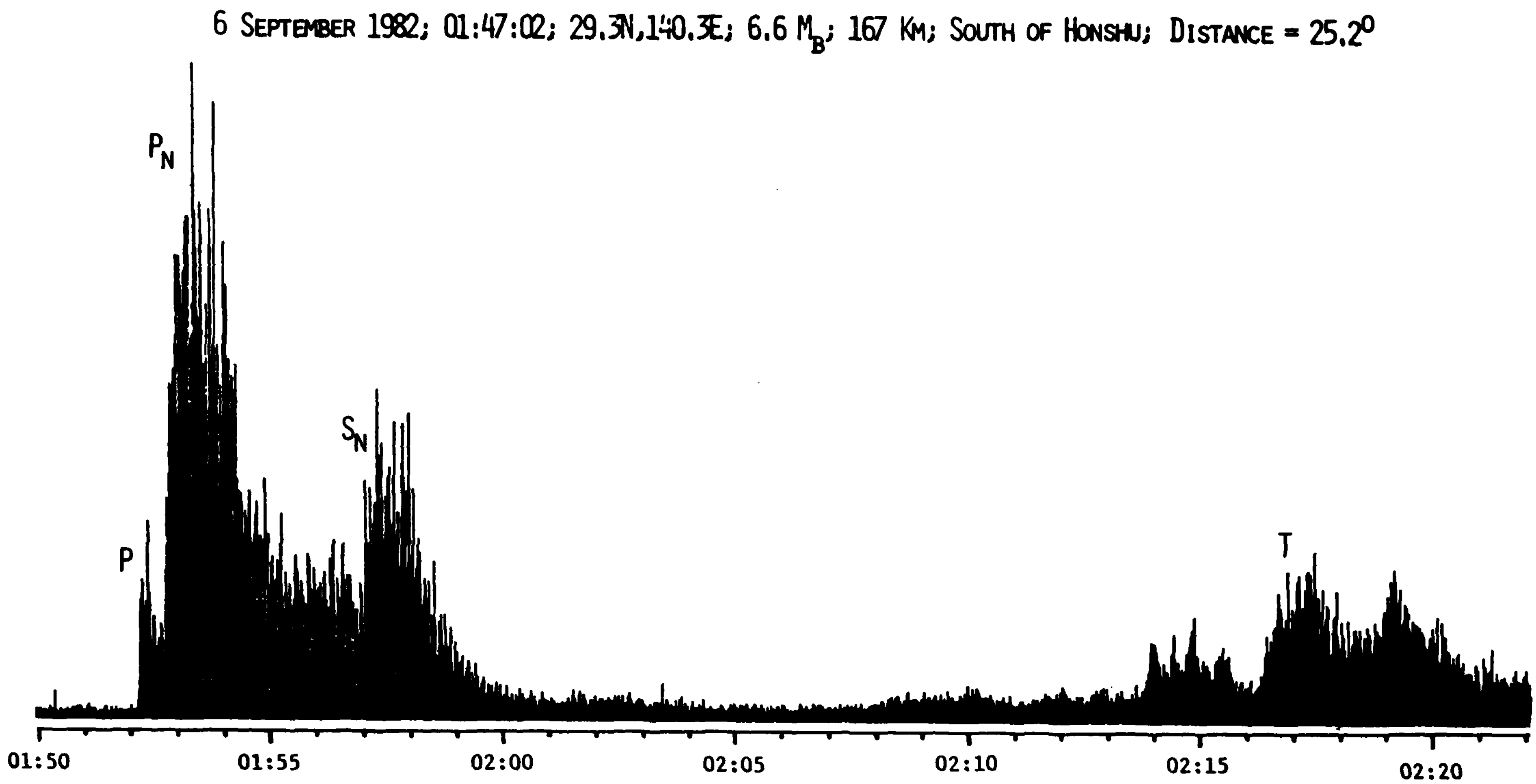

Fig. 2. Digitally rectified and compressed plot of P, Pn, Sn, and T phases for an earthquake south of Japan recorded by the Wake Island hydrophones.

OCEAN-SURFACE REFLECTIONS

Other potentially significant contributors to the Pn, as well as Sn, wavetrains are multiple ocean-surface reflections of all Pn/Sn variations observed on the ocean bottom that are capable of becoming compressional water waves at the sediment-water interface. Such reflections have already been proposed in synthetic Pn model studies (Gettrust and Frazier, 1981). An example of an ocean-surface reflection is shown in Figure 3.

PN/SN PHASES AT GREAT DISTANCES

Another puzzling aspect of Pn/Sn propagation is the frequent absence or weakness of Sn, yet presence of Pn, at great distances (often more than 4000 km) throughout the North Pacific (Walker, 1977a and b) and Central Pacific (Talandier and Bouchon, 1979), in spite of stronger Sn's than Pn's for relatively homogeneous travel paths across the deep Northwestern Pacific Basin.

A possible explanation is that paths other than those across the relatively homogeneous deep Northwestern Pacific Basin are likely to encounter relatively large lateral changes in the crust and upper mantle. These changes would have to be of such a nature so as to reduce Sn signal strength without seriously affecting the Pn phase. Large lateral changes could be produced by plateaus, rises, ridge systems, island and seamount chains, fracture zones, transform faults, fossil arcs and trenches, and rafted continental fragments.

Specific examples of Sn's severely attenuated by large lateral variations are found in recordings of earthquakes from the Solomon Islands area on the Wake hydrophones. Although these events are at distances comparable to events from Japan and the Kurils which have strong Pn/Sn phases (Fig. 1), only their Pn's are well recorded (Fig. 4). Furthermore, this effect cannot be attributed to differences in source mechanisms because Sn's from the area are well recorded at Ponape (examples of such recordings are shown in Fig. 5; refer to Fig. 6 for the location of Ponape). A reasonable explanation would appear to be the large structural changes associated with the transition from the shallow Ontong Java Plateau to the deeper Northwestern Pacific Basin (Figs. 6 and 7). An additional factor may be the extension of the Caroline Archipelago through this region.

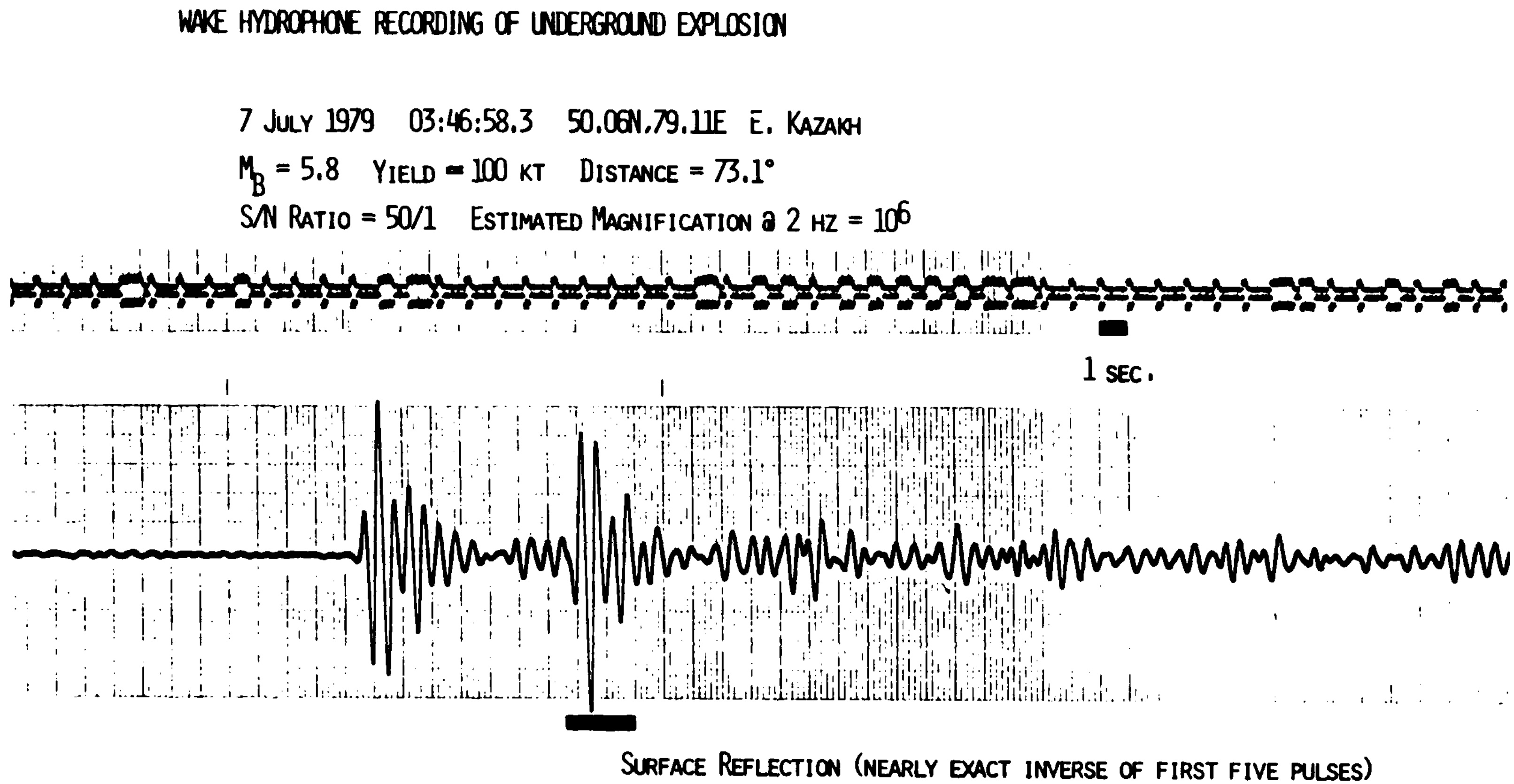

Fig. 3. An example of ocean-surface relfections.

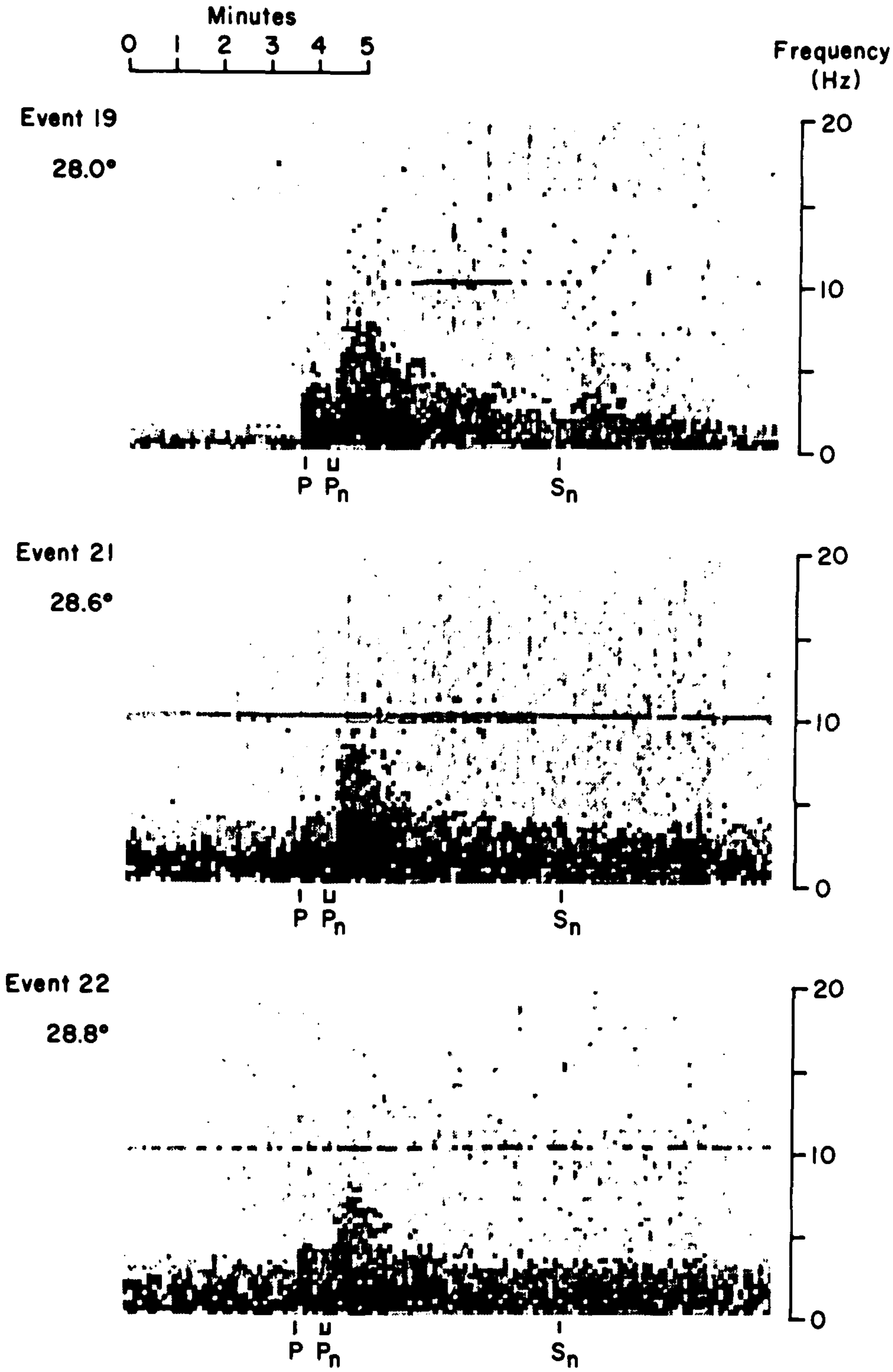

Fig. 4. Some spectrograms for earthquakes having portions of their travel paths to Wake under the Ontong-Java Plateau. Computational procedures are the same as used in Fig. 1.

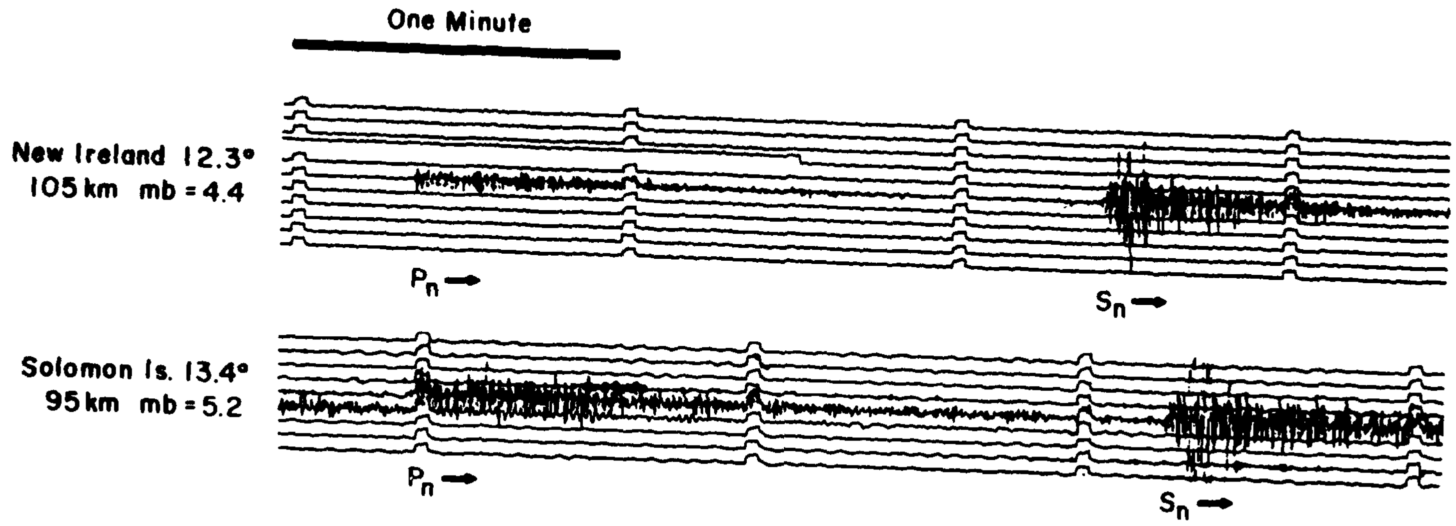

Fig. 5. Examples of Pn and Sn phases recorded at Ponape on the northern margin of the Ontong-Java Plateau. Of more than forty events from the New Ireland-Solomon Islands area, amplitudes of Sn phases are at least comparable to, and frequently larger than, those of their respective Pn phases.

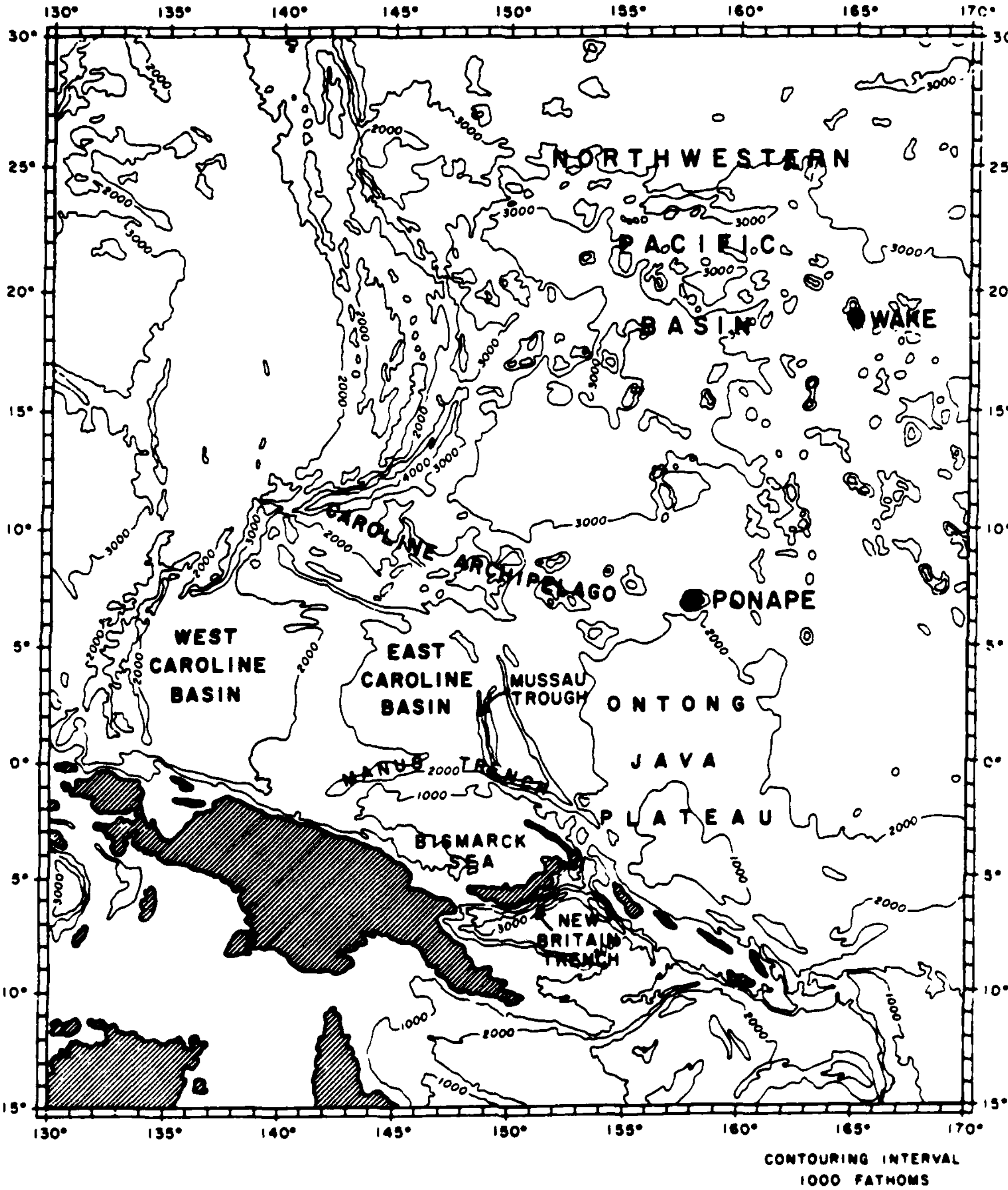

Fig. 6. Bathymetry map of the Northwestern Pacific area.

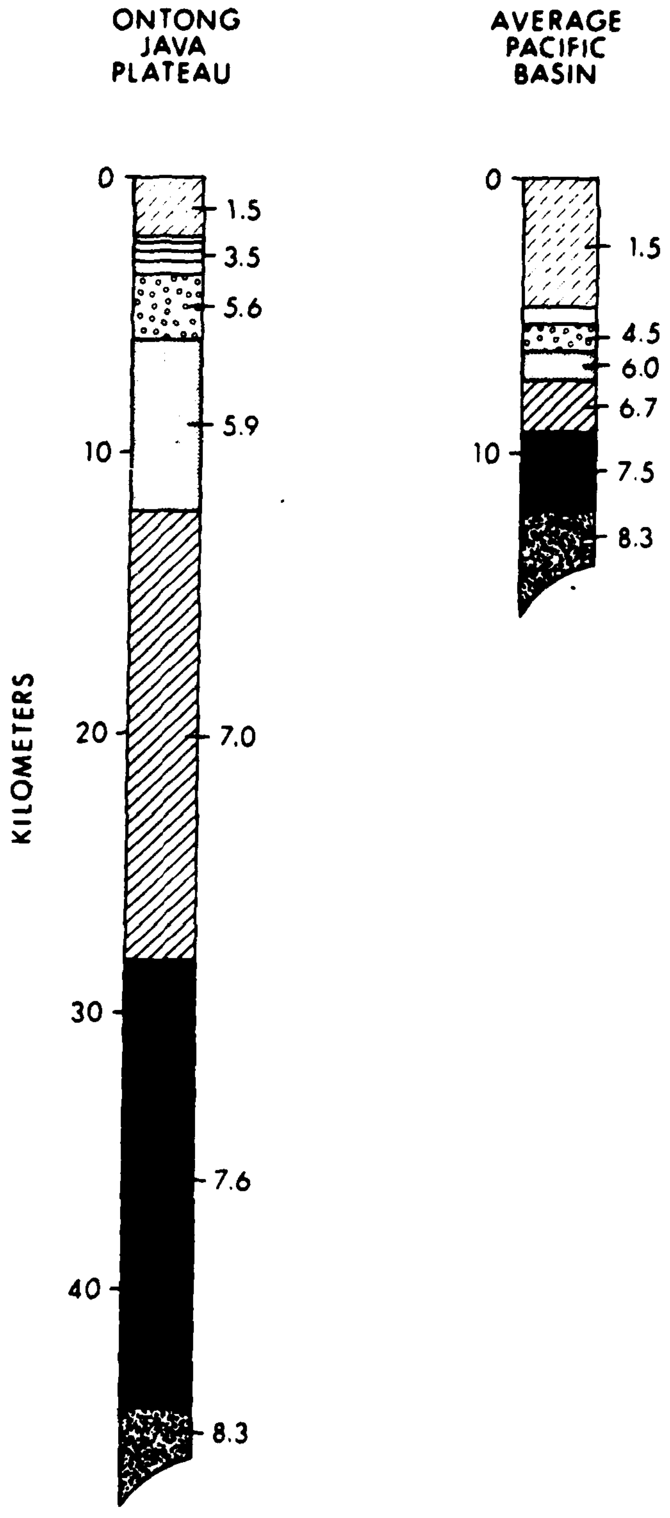

Fig. 7. Section profiles for the Ontong-Java Plateau and Pacific Basin (from Hussong et al. 1979).

T-PHASE MECHANISMS

Tolstoy and Ewing (1950) recognized the importance of a sloping bottom in the production of T-phases, and Milne (1959) provided a specific mechanism involving multiple reflections between the surface of the ocean and its downward sloping bottom. Although such a mechanism could be significant for T-phases originating in areas with the appropriate downward sloping bottom, many strong T-phases have been observed from regions where the ocean floor is level or at a greater depth than adjacent areas in the direction of the receiver (Johnson _et al_., 1968; Duennebier, 1968). Included among these regions are the deep ocean floor off the coast of California and Oregon, the deep ocean floor south of the subducting margins of the Northern Pacific and east of the Western Pacific, and the East Pacific Rise.

Because of these observations, a mechanism other than downslope propagation is required. Some suggestions included ocean surface scattering (Johnson _et al_., 1968), scattering from the sea floor by fault scarps near the source (Johnson and Norris, 1970), and coupling of Stoneley waves into the SOFAR channel (Biot, 1952; Duennebier, 1968). All of these proposed mechanisms, including downslope propagation, presume that the energy of the T-phase comes ultimately from P and, perhaps, S phases travelling upwards through the crust to the ocean bottom near the T-phase source location; however, with such a presumption, none of the proposed mechanisms is capable of explaining T-phase forerunners. In describing these forerunners, Johnson (1963) stated:

> "The time of earliest perceptible arrival is probably primarily a function of magnitude as the signal emerges slowly from the ocean background noise...Early, low-level arrivals, undetected in most T-phase recordings, must be normal-mode ground waves or, at least, must have followed a ground path for a significant portion of their travel."

He also states that in one instance (a 7.0-Ms earthquake from the Kurils) the forerunners were so early that "the transformation from P or S waves to sound channel waves would have to occur at a distance of about 17 to 21° from the source toward the receiver." In describing a P, S, and T phase (Fig. 8; actually the P and S phases are Pn and Sn phases) from a large (6.2 mb) earthquake in the Marianas recorded on hydrophones near Enewetok Atoll at a distance of about 18°, Duennebier (1968) notes that "the T phase does not have a definite onset and that energy was continuously received at the hydrophone after the arrival of the P wave."

Both authors suggest that the apparent coupling into the SOFAR channel was due to normal, mantle P or S waves or both refracted by the Emperor Seamount Chain (Johnson, 1963) and by several groups of seamounts in the Northwestern Pacific Basin (Duennebier, 1968). In terms of frequency content and strength of signal, however, the energy from the long-range, high-frequency, guided Pn and Sn phases seems more likely to be coupled into the SOFAR channel than the mantle-refracted P and S phases which are extremely weak at high frequencies. At teleseismic distances frequencies of P and S generally do not exceed 3 or 4 Hz, while Pn, Sn, and T frequencies may be as high as 20 Hz (Figs. 8 and 9).

For large earthquakes sufficient energy could be contained in the Pn/Sn phases for coupling into the SOFAR channel throughout the travel path to the receiver. This coupling could occur by any of the mechanisms proposed for the generation of the T-phase (i.e., scattering or Stoneley waves or both), with seamount enhancement remaining as an important consideration. In effect the Pn/Sn phases would serve as potential sources of energy at the sediment-basement (or water-sediment) interface. As Pn/Sn energy declines with increasing distance, the amount of energy coupled into the SOFAR channel would also decline, thus producing a T-phase signal which would slowly emerge from the ocean background noise. A recently recorded example of such an emergent T-phase is shown in Figure 2. Energy arriving at 02:08 corresponds to a Pn path of 9.6° at 8.0 km/sec and a T-phase path of only 15.6° at 1.5 km/sec.

Finally, an additional explanation for Sn appearing to have relatively more energy than Pn with increasing distance could be that Pn energy is coupled more efficiently into the SOFAR channel than Sn energy is.

SUMMARY

Vast regions of the world's oceans are characterized by thinly layered, homogeneous crustal and uppermost mantle structure. This report suggests that comprehensive observations of high-frequency phases, often referred to as Pn/Sn, throughout the Western, Northern, and Central Pacific may be explained by a waveguide which extends upward from the uppermost mantle through the crust and, to some extent, into the sedimentary layers and the entire water column. Pn energy is more efficiently propagated upward into the sedimentary column than

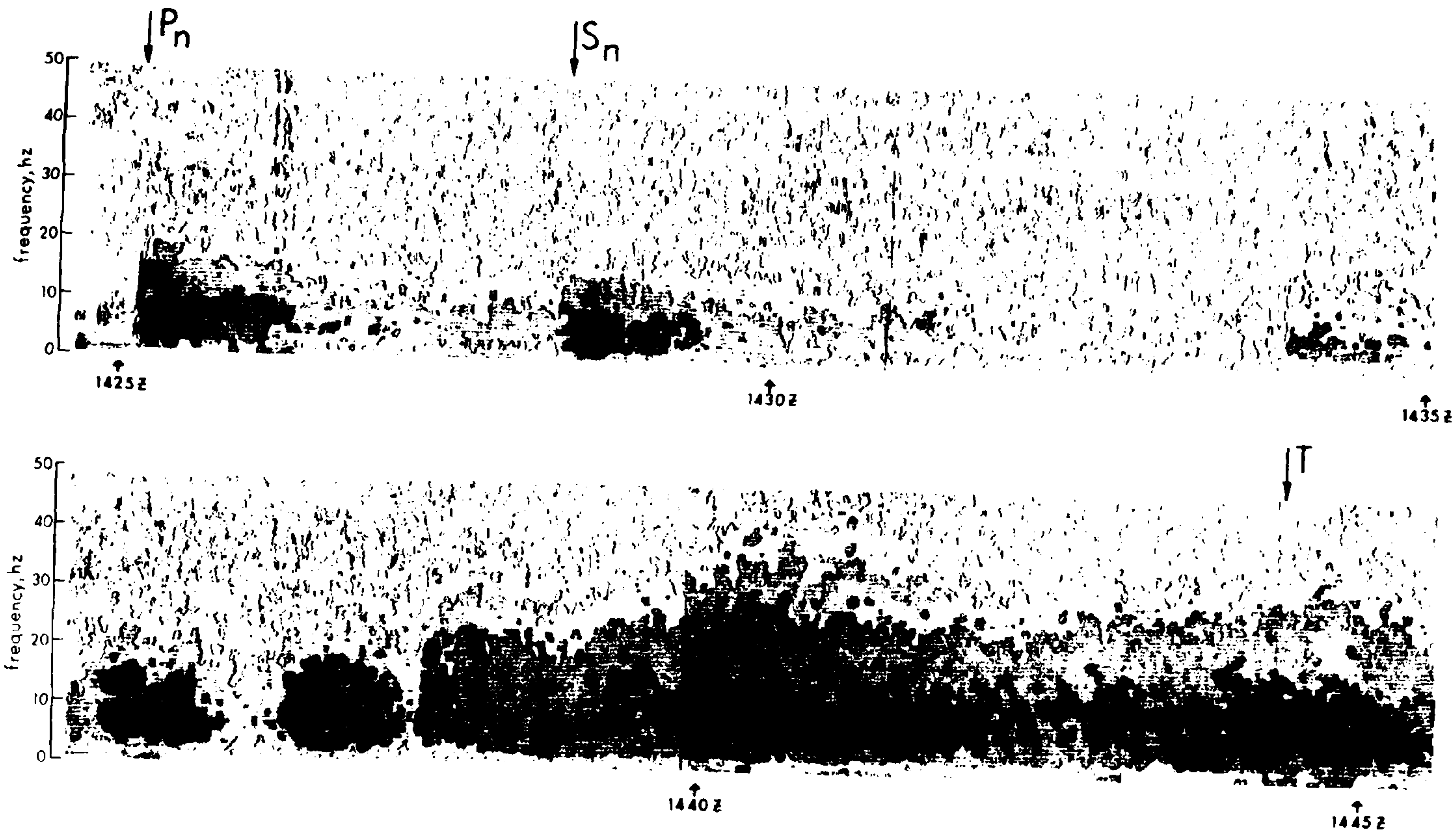

Fig. 8. Sonogram of Pn, Sn, and T phases (after Duennebier 1968). Note that the T-phase does not have a definite onset. Instead, energy appears to be continuously received at the hydrophone after the arrival of the P wave.

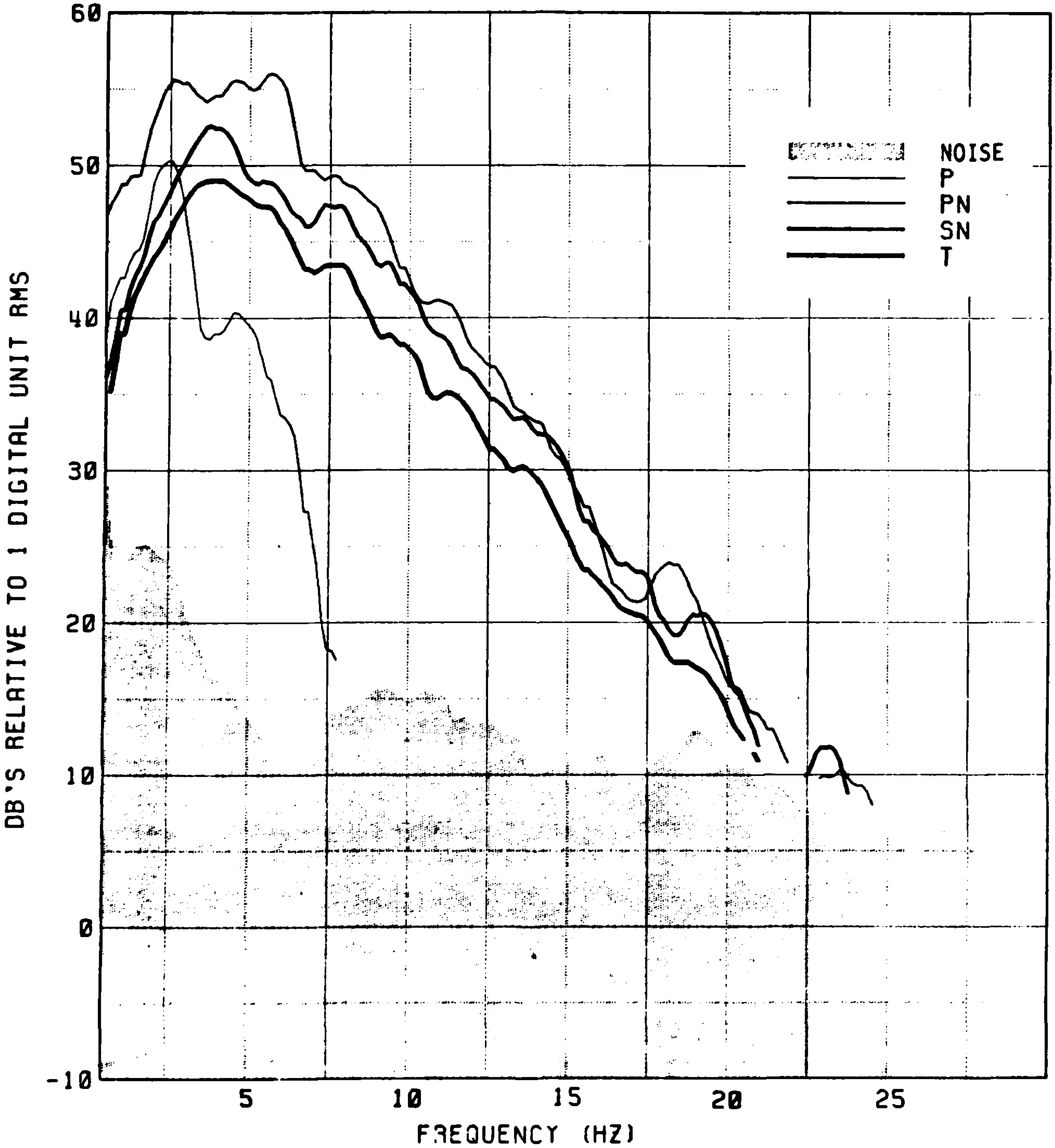

Fig. 9. Spectrums for the P, Pn, Sn, and T phases shown in Figure 2.

Sn energy, and, because of this, Pn is more rapidly attenuated than Sn. As distance increases, Pn's losses above the basement-sediment interface produce a relative strengthening of the Sn phase, such that Sn eventually has more energy than Pn.

The observed data also suggests that the long Pn/Sn wave-trains may, in part, be the result of multiple ocean-surface reflections near the receiver.

Pn to Sn and Sn to Pn conversions are suggested to explain Pn wavetrains consistently longer than the wavetrains of Sn. These conversions could occur when Pn or Sn energy passes through the basement-sediment interface and is returned to that interface by way of reflections from the ocean surface to continue in the waveguide, at least in part, as Sn or Pn phases. Such conversions might be produced at any of the interfaces encountered by Pn or Sn, or their converted phases.

In conjunction with the scattering mechanisms and Stoneley wave propagation already proposed to explain T-phase observations, Pn/Sn phases as sources of energy at the sediment-basement interface could explain: (1) the generation of T-phases in regions not having the downward sloping ocean bottom required by the classical downslope mechanism of Milne (1959) and (2) T-phase forerunners extending well ahead of the peak arrivals--occasionally beginning perhaps as early as the Pn and/or Sn phases. Also, another explanation for Sn having more energy than Pn is provided if Pn energy is more efficiently transmitted than Sn energy into the SOFAR channel.

Finally, the observed data suggest that large lateral variations in the crust and upper mantle may produce significant reductions in Sn signal strength without seriously affecting the Pn phase.

CONCLUSIONS

Although many puzzling observations of long-range oceanic Pn/Sn phases may be resolved by the suggestions presented in this report, many of these suggestions can, and should, be tested quantitatively. These analyses could include the re-examination of existing data, new experiments, and theoretical modeling efforts leading to the generation of complete synthetic seismograms. Furthermore, one should not forget that the mechanisms for the generation and propagation of the main Pn and Sn phases are still not generally agreed

upon, nor have proposed models been matched in a comprehensive manner with observations. Such tasks are of utmost importance if the phenomenon is to finally achieve the status it deserves as a major geophysical feature and tool for mapping the crust and uppermost mantle of the world's oceans--this after nearly fifty years of being little more than an obscure curiosity.

Regarding the T-phase, it seems appropriate that the earth's most efficient acoustical waveguides, the SOFAR channel and the Pn/Sn waveguide, finally should be related; and in the hypothesis formulated in this report, the SOFAR channel is energized by leakage from the Pn/Sn waveguide. The recognition of this relationship could be an important, and perhaps critical, factor in arriving at a comprehensive understanding of these oceanic phases.

> "In the bulletin of the Harvard Seismograph Station, under date of September 15, 1935 attention was directed to the unusual character of certain records from the vicinity of 17°N, 62°W. One of the novel features was a short-period phase about 23 minutes after P. It has become known as T, for third, with P and S constituting the first and second groups of short-period waves of similar general appearance...Actually, many features of P and S are abnormal on this and later records from certain areas at this distance range, and work on that part of the problem is in progress, but the investigation of T has been undertaken first." (Leet *et al*., 1951)

ACKNOWLEDGMENTS

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Special appreciation goes to Charles McCreery, George Sutton, and Loren Kroenke for constructive comments and discussions. Editorial assistance was provided by Barbara Jones.

SUPPLEMENTARY NOTE

It may be appropriate at this time to suggest that a new name be given to the high-frequency compressional and shear phases often observed at great distances in the world's oceans. The difficulty with the nomenclature used to date is that: (1) an, as yet, unsubstantiated relationship to the well known and much studied longer-period Pn/Sn phases of continents is inferred; and (2) the environmental feature most strongly linked to the observations is not cited. Thus, a more logical term would be "Ocean P" or "Ocean S" with the abbreviations being "Po/So." With this change, those unfamiliar with the phenomenon would not be as likely to make the false assumption that the phases are similar to continental Pn and Sn. Such assumptions in the past have been a major stumbling block in stimulating interest and support for "Po/So" research.

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The combined effects of: (1) differing efficiencies between Pn and Sn energy transmission across the basement-sediment interface; (2) ocean surface reflections; (3) Pn to Sn conversions; and, (4) large lateral variations in the crust and upper mantle are used to formulate a working hypothesis which appears to explain, qualitatively, many observations of high frequency Pn/Sn phases throughout the western, northern, and central Pacific. Also, the concept of Pn/Sn phases as sources of energy at the basement-sediment interface is suggested as a possible mechanism for T-phase generation through scattering or Stoneley wave generation.

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CORRECTIONS AND ADDITIONS

Pg. 12 line 5
after "... (Duennebier, 1968)."
add " Northrop (1972) also suggests a transformation from P to T at a distance of about 17° to explain the earliest perceptible T phase arrivals on Oahu hydrophones from the 28 March 1964 Alaskan earthquake."

Pg. 12 line 27 (last sentence of 2nd paragraph)
"... path of 9.6° at 8.0 km/sec and a T-phase path of only 15.6°..."
should read "... path of 10.1° at 8.0 km/sec and a T-phase path of only 15.1°..."

Pg. 12 line 32 (last sentence of 3rd paragraph)
after "... than Sn energy is."
add " Conversions of Pn or Sn to T near the receiver could also strengthen and extend the Pn and Sn wavetrains."

Pg. 15 line 28 (last sentence of 4th paragraph)
after "... the SOFAR channel."
add " Conversions of Pn or Sn to T near the receiver could strengthen and extend the Pn and Sn wavetrains."

Pg. 18 McCreery *et al.* has since been published in volume 10, p. 59-62, of Geophysical Research Letters, 1983.

Pg. 19 add " Northrop, J. 1972. T-phases, in The Great Alaskan Earthquake of 1964: Oceanography and Coastal Engineering, Nat. Acad. of Sci., Washington, D.C., p. 19-24."

Dan Walker

APPENDIX IV

A Preliminary Informal Comparison
of Signal/Noise Capabilities
Between The Wake Bottom Hydrophone Array,
The Ocean Sub-Bottom Seismometer,
And Ocean Bottom Seismometers

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Abstract. A comparison has been made between noise levels and signal/noise (S/N) ratios of the Wake Bottom Hydrophone Array (WBHA), the Ocean Sub-Bottom Seismometer (OSS), and Ocean Bottom Seismometers (OBS's) using data which has recently become available. The general purpose of this comparison is to evaluate WBHA as a possible alternative or complement to deep sea drillhole seismometers such as the Marine Seismic System (MSS) now being developed and tested for possible deployment in the Northwestern Pacific Basin. Absolute noise measurements show roughly comparable levels between WBHA and OSS, although the OSS data was scant. S/N ratios were found to be approximately 17 dB greater on the OSS than on a nearby OBS over the band 2-20 Hz, and 10 dB greater on WBHA than on a nearby OBS over the band 1-20 Hz. Improvements in WBHA S/N ratios of at least 3 dB and up to 11 dB, by stacking the water surface reflections and all 6 hydrophone signals, may be gained depending upon the level of coherence between signals. An evaluation of coherence levels has revealed apparent differences between the individual hydrophone/cable responses. Appropriate correction factors for these differences will have to be determined and then applied to the data before coherence levels are accurately known. The limited amount of data available for the noise and S/N ratio comparisons, and the indirect route by which the comparisons were made are arguments for attaching a certain amount of skepticism to the results. Additional OSS data which will become available after May 1983 should provide for a more direct and statistically stronger comparison.

Introduction. Considerable effort has been expended in recent years to develop a deep-sea borehole seismometer such as DARPA's Marine Seismic System (MSS) and the Hawaii Institute of Geophysics (HIG) Ocean Sub-Bottom Seismometer (OSS), which can be deployed down drillholes in the ocean bottom. Impetus for this effort has come from a desire to make high quality seismic observations on the vast portions of the earth covered by oceans. Although seismic observations in the oceans are capable of being made more or less routinely using Ocean Bottom Seismometers (OBS's) sitting on top ot the sediments, it has often been presumed that an instrument located below the sediment-basalt interface would have significantly greater signal/noise (S/N) ratios, at least for upwardly arriving signals. This is because such an instrument should receive more energy from seismic signals arriving from below, and less energy from noise propagating downward through the water column and sediments.

Since July of 1979, HIG has monitored on a nearly continuous basis, an array of hydrophones located near Wake Island in the Northwestern Pacific Ocean. This array consists of six hydrophones on the ocean bottom at 5.5 km water depth in a 40 km, 2-dimensional grouping, and 3 pairs of hydrophones at 1 km water depth (SOFAR channel) spread over 300 km. Recordings from only two or three of the hydrophones were made prior to September 1982; subsequently recordings from eight of the hydrophones have been made. The array was installed with the hydrophones hardwired to Wake Island more than 20 years ago for the purpose of recording transient, non-tectonic signals at frequencies above 10 Hz. Recordings made by HIG indicate that the hydrophones are also excellent seismic sensors in at least the band 0.5-20 Hz. The capability to evaluate the full potential of this array as a seismic tool has only been possible since the September

1982 upgrading. One aspect of this evaluation is to compare the noise levels and the S/N ratios between the Wake Bottom Hydrophone Array (WBHA), a sub-bottom seismometer (the OSS), and an OBS. Although data for a direct comparison does not yet exist, a somewhat indirect comparison has been made using data collected recently. That comparison is the subject of this report.

Absolute Background Noise Levels. In September 1982, during Leg 88 of the R/V Glomar Challenger, the OSS was successfully deployed off of the Kuril Islands, 378 m below the ocean floor and 20 m below the sediment-basalt interface. For a period of about 2.5 days, data was recorded from the OSS directly on the ship. Then a 2 month continuous recording package was dropped over the side for pickup sometime in May 1983. Briefly overlapping this 2.5 day period was the nearby deployment of several HIG OBS's. Noise levels measured at about the same time by the OSS vertical seismometer and a representative OBS vertical seismometer are shown in Figure 1. Although the general shape of the curves is similar, the difference in absolute levels is striking. Some of this difference is due to the impedance difference between the basalt and the top of the sediment. Smaller signals, as well as lower noise levels, would be associated with the higher impedance of the basalt. If normalized to the sediment impedance by a $\sqrt{\rho c}$ correction, where ρ is density and c is compressional velocity, the OSS noise curve moves up by about 9 dB to the position of the dashed curve. The remaining differences between these two noise curves may reflect the attenuation of downwardly propagating noise energy. Some of this noise is certainly generated by the research vessels which were operating overhead.

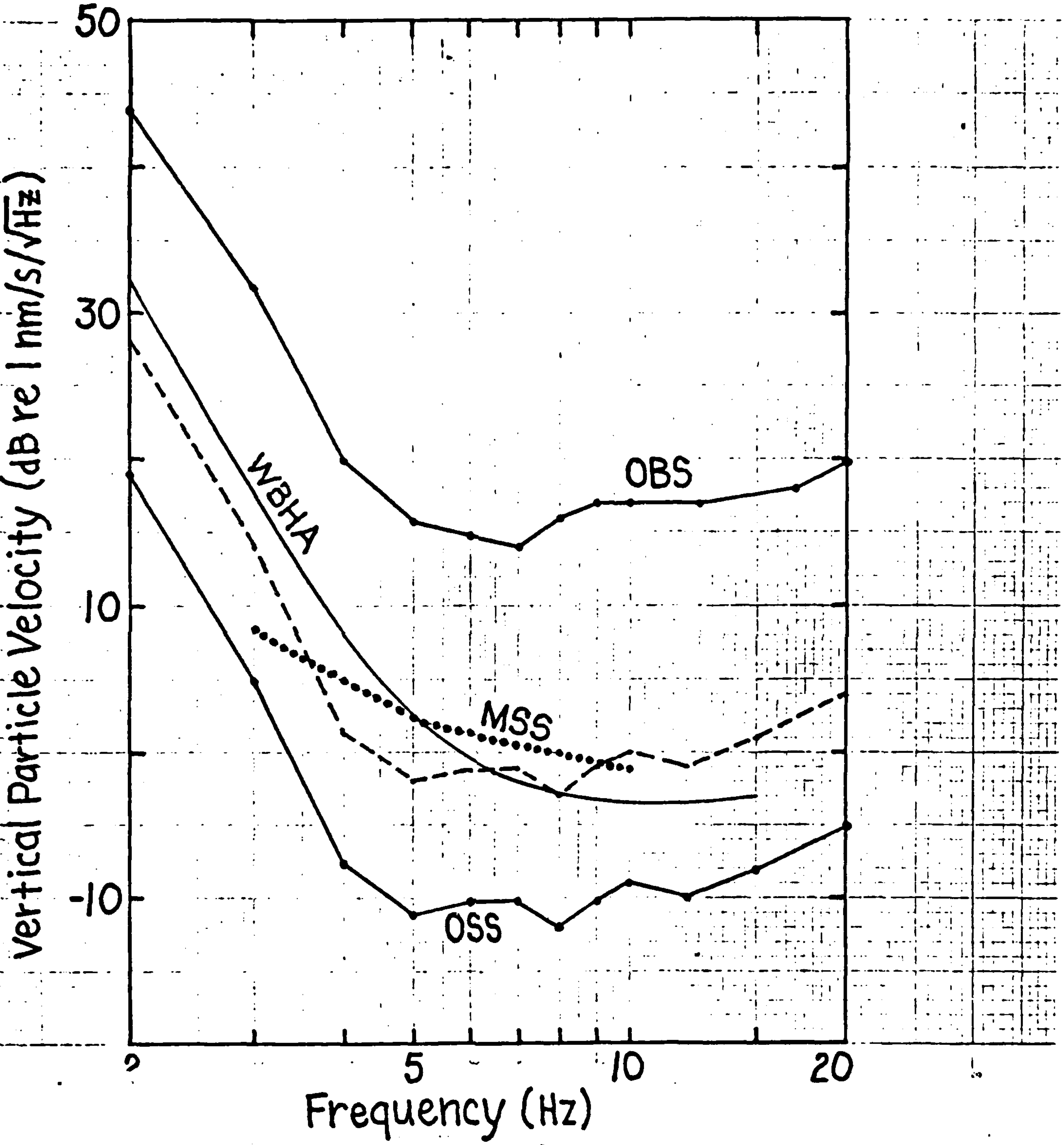

Figure 1. Background noise level measurements from WBHA (one hydrophone, 52 samples over 18 months), from an OBS and the OSS deployed in the NW Pacific Basin (vertical component-1 simultaneous sample) and the MSS in the Atlantic (vertical component-1 sample). The dashed curve is the OSS curve adjusted by 9 dB to normalize it to sediment impedance.

Also shown in Figure 1 is the average background noise for one of the Wake bottom hydrophones, determined from 52-2 minute random noise samples taken over a period of 18 months. Pressure has been converted to vertical particle velocity by the expression $\dot{x}=P/\rho c$, where $\dot{x}$ is vertical particle velocity, P is the pressure, ρ is seawater density, and c is the speed of sound in seawater. Although the hydrophone noise is certainly not generated entirely by vertically arriving pressure waves (thus vertical particle velocity), this conversion is useful to determine an equivalent noise level for comparison.

For reference purposes, the noise curve for MSS in the Atlantic has also been plotted. It is not known if an impedance correction need be applied to this curve and so none has been.

The OBS and OSS noise curves may not be representative of average noise levels because they are only 1 sample and because of the ship generated noise. The relationship between these two curves however, is probably significant, and illustrates the decrease in noise level which can be achieved by a downhole instrument. The average noise level of the Wake bottom hydrophone is similar to that of the normalized OSS curve. These two curves are also comparable to the MSS curve for frequencies between about 4 and 10 Hz.

Signal/Noise. Although absolute noise levels are important for evaluating the usefullness of a seismic sensor, a more important parameter is S/N. Ideally, a comparison should be made of an earthquake or explosion signal recorded simultaneously on the Wake hydrophones, an OBS, and a downhole instrument, all located in close proximity. Unfortunately, these data do

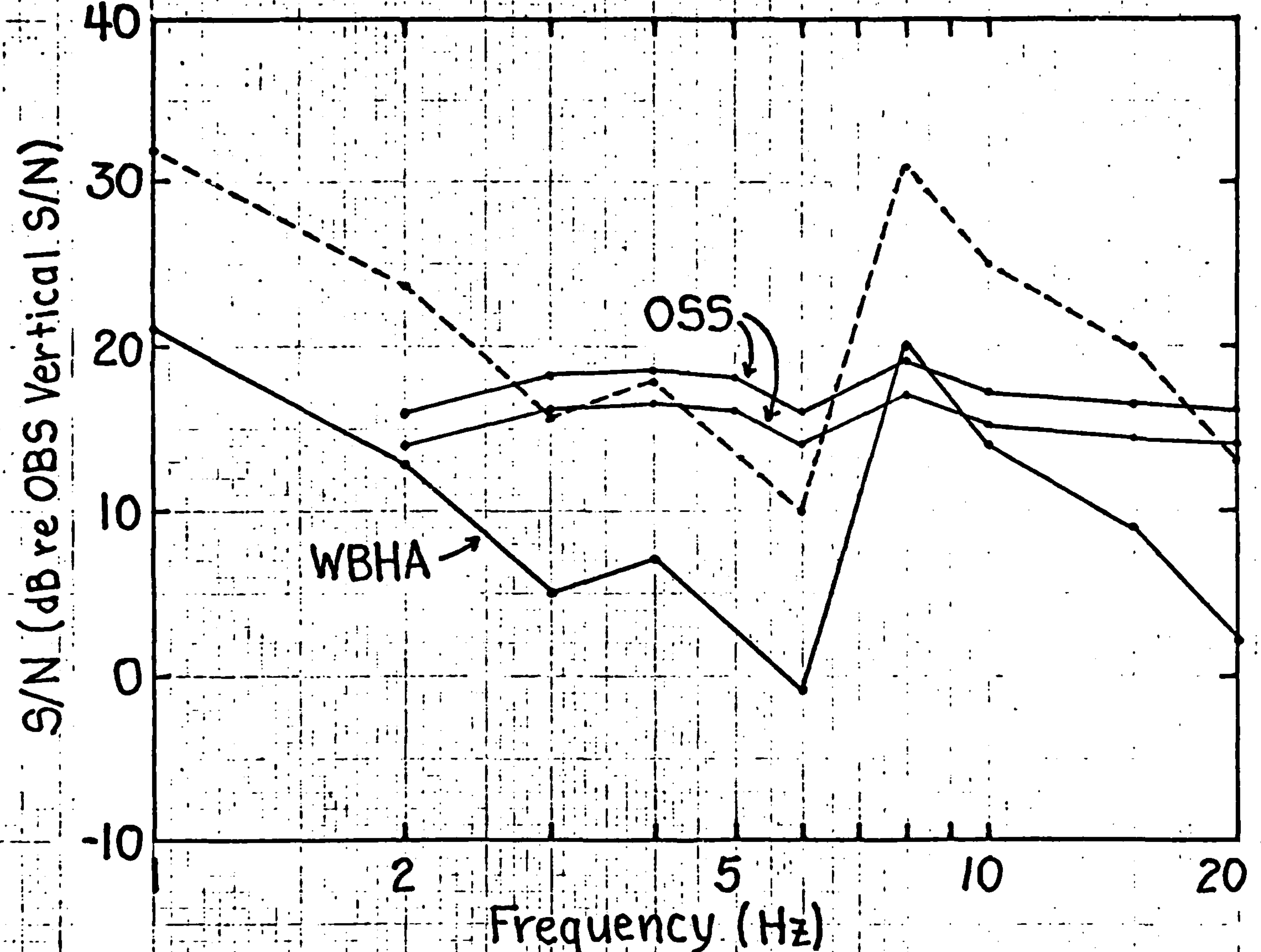

Figure 2. S/N measured on WBHA and on the OSS relative to S/N measured on nearby OBS's as described in the text. The lower OSS curve is based on shot S/N data, while the upper OSS curve is based strictly on noise data. The dashed curve is the WBHA curve raised by 11 dB to show the potential S/N by signal stacking.

not exist. With a few assumptions however, an indirect comparison can be made using data which do exist.

Within the 2.5 day period of OSS data previously mentioned is the record of a 126 pound shot at 80 km distance. It occurred, however, after the last of the nearby OBS's had been recovered. Fortunately, during the OBS deployment there was an 1800 pound shot also at 80 km distance from one of the OBS's. After making some assumptions and corrections, a comparison between ground arrivals on these records may yield information about the improvement in S/N between the OBS and OSS. The first correction is one for shot size, equal to the ratio of the shot weights to the power 0.66, or 15 dB. The spectral shape of the two shot records is very similar so a common shape was assumed. The second correction is for temporal changes in background noise which occured during the time between the shots. These effects were compensated for by assuming the same OBS/OSS noise ratios found for the simultaneous data discussed in the previous section. The resulting ratio of (OSS S/N)/(OBS S/N) is plotted in Figure 2.

Also shown is a curve which represents the possible gain in S/N of the OSS relative to the OBS based strictly on the simultaneous noise data. A correction for the impedance difference between the sediment and basalt has been applied. No assumptions were made about possible losses in upcoming signal levels between the OSS and OBS, and the effect of these would be to raise this curve by some amount. However, the near agreement in absolute level between this curve and the one based on the shot data may imply that these losses are not significant for the frequencies observed. (The parallel nature of the two curves is not significant but is due to having used the simultaneous noise data to correct for temporal differences in the

shot data.) On the average, these data support an improvement in S/N over the range 2-20 Hz of about 17 db.

A more direct comparison can be made between WBHA and an OBS. In August of 1981, HIG deployed an OBS array along a 1500 km line in the NW Pacific, and one of these OBS's was located within the bounds of WBHA. A strong Po (i.e.,"Ocean P"; formerly called high-frequency Pn) signal from a large earthquake in the Kuril Islands was recorded simultaneously by this OBS and by a recording system connected to 3 of the hydrophones of WBHA. A comparison between the OBS vertical geophone and WBHA could not be made because that sensor was not working properly on the OBS. Consequently, the OBS hydrophone signal has been used. To correct for any difference in S/N between the OBS vertical and OBS hydrophone, a factor equal to the actual measured difference in S/N between the vertical geophone and hydrophone for this same signal recorded on another OBS at a closer epicentral distance was added to the S/N of the hydrophone. This factor averaged 1 dB over the range 1-20 Hz. Plotted in Figure 2 is the ratio between the average S/N of the 3 Wake hydrophones and the S/N measured on the OBS hydrophone with the previously described correction added. The somewhat wild behavior of this curve, such as the jump from -1 dB at 6 Hz to 20 dB at 8 Hz, is not entirely understood. It may be related to resonances in the OBS package which contribute to the OBS noise level, or it may be due to other factors which could not be identified by the analysis of only this one signal. For most frequencies, however, the WBHA data show an improvement in S/N, and this improvement averages roughly 10 dB over the range 1-20 Hz.

A natural question to ask is: "Why should there be any difference at all in S/N between the OBS hydrophone and the nearby WBHA hydrophones, since they are both lying at the top of the sediment column?" One explanation

might be that the OBS used for comparison was particularly noisy due to noise sources in the water very close by or due to electrical noise in the amplification and recording system. Evidence which generally contradicts this hypothesis is that the noise levels measured on the other OBS's in the array were comparable. An alternate explanation may be related to the 20 year age of the array, and the possibility that the bottom hydrophones are now buried under a layer of sediment. Burial of the hydrophones would isolate them from noise generated by bottom water currents flowing around them, and also possibly from sediment surface phenomena such as Stonely waves. Although these explanations are not supported by direct evidence at this time, it would certainly be worthwhile to learn that shallow burial of a hydrophone under the sea floor sediment would greatly improve its S/N capabilities.

Coherence Across WBHA. An important aspect of current research at HIG is the investigation of coherence of teleseismic body waves across the 40 km aperture of WBHA. The impact of near receiver structure on these signals may be small due to the thin and relatively undisturbed nature of the oceanic lithosphere underlying WBHA. High coherency would have important implications for: (a) the planning of any future ocean seismic arrays; (b) studies of first arrivals requiring a great deal of timing precision; (c) studies requiring precise determination of seismic amplitudes (such as yield determination), and especially (d) studies of small signals where enhancement of S/N is desired (such as detection). Highly coherent signals may be added (with appropriate propagation delays) to yeild an increase in S/N equal to the square root of the number of sensors (for uncorrelated noise). At WBHA the theoretical increase in S/N would be equal to about 11

dB (3 dB of which comes from the first water surface reflection which is well established as having nearly perfect coherence with the initial arrival). Data from 3 WBHA hydrophones, collected prior to September 1982 on slow-speed cassettes, indicated high levels of coherence for a sampling of teleseismic P arrivals. Unfortunately, these data were not especially suited for this type of analysis because of timing inaccuracies and the suspect fidelity of the recording medium. Since September 1982, however, continuous data from 5 of the 6 bottom hydrophones have been collected digitally, essentially solving the timing and fidelity problem , and providing a format for a much speedier and more accurate analysis of the data. Software for the necessary quantitative analysis is still under development. However, "eyeball" checks for coherency have been made for a few of the digitally recorded teleseismic P phases with large S/N. The results are encouraging although not entirely conclusive.

Figure 3 illustrates the kind of broadband coherency which seems to be characteristic of the different P arrivals examined. Some features are "in phase" across the array while others are not. Certain pairs appear more coherent than other pairs. This relationship does not seem to be a function of epicentral distance or azimuth. Certainly a large improvement in S/N would not be expected from the stacking of these signals as they are.

Possible reasons for the observed difference in signals may be classified into the following categories: (a) major differences in the coda exist for very small changes in takeoff angle (for Figure 3, much less than 1°); (b) variations in lithospheric structure directly beneath the array have a significant impact on the signals; and (c) the hydrophone/cable responses differ significantly across the array. If the

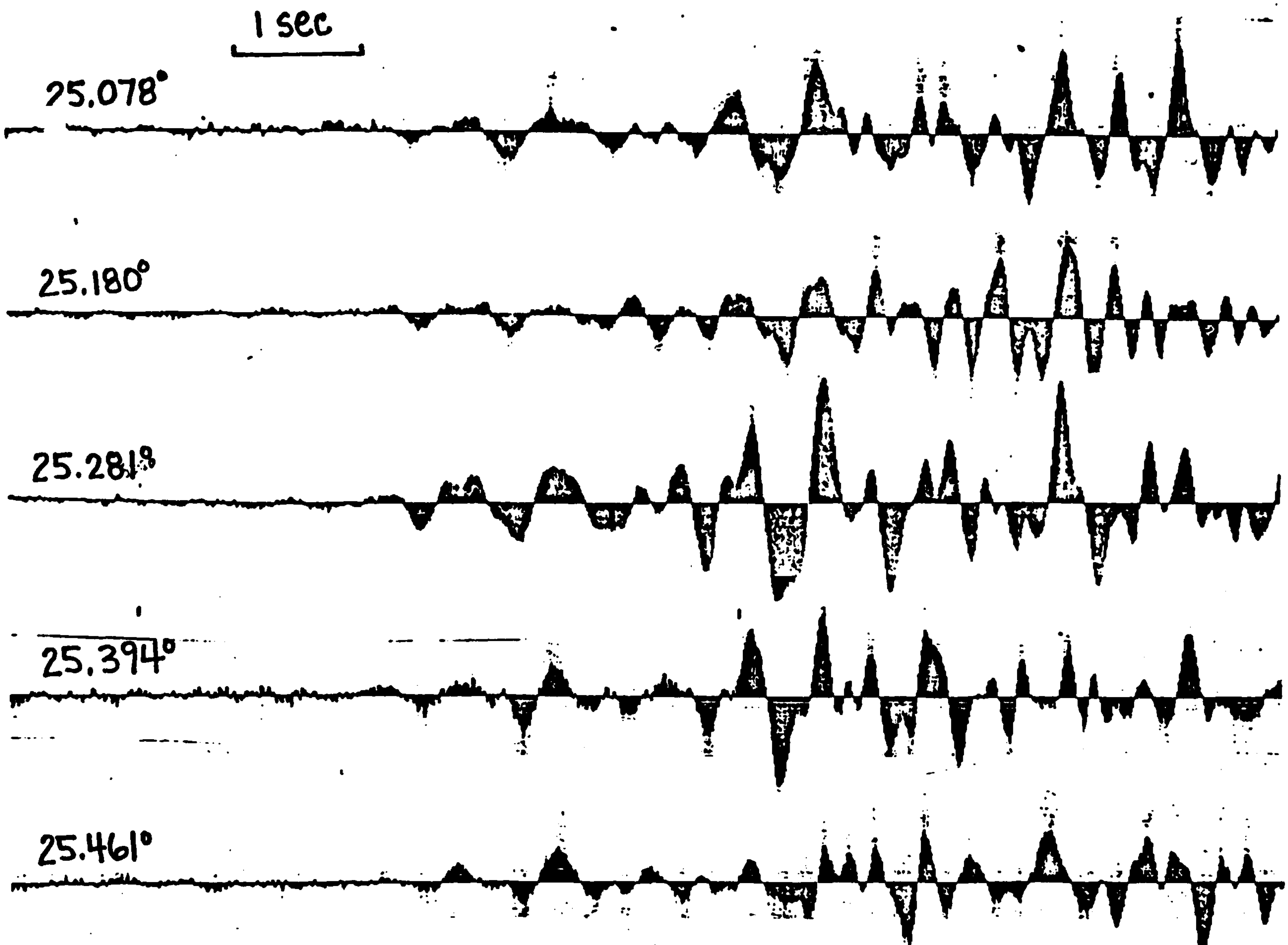

Figure 3. Unfiltered first arrivals of P across the Wake bottom hydrophones from an earthquake south of Honshu, Japan (6 Sept. 1981, h=167 km, m=6.6). Traces have been offset by travel time differences.

explanation is (a) then little, if any, improvement in coherence can be expected by massaging the data. If the explanation is (b) then significant improvements in coherence are possible, provided the lithospheric response does not vary greatly with small changes in azimuth or angle of incidence of incoming P arrivals. If the explanation is (c) then an even more significant improvement in coherence is possible. The technique which will be used to investigate (b) and (c) is basically a calculation of amplitude and phase differences between hydrophones for a given signal as a function of frequency. If (c) is true, then these differences should be consistent regardless of what kind of signal is being recorded - P, Po, So, T, or noise. If (b) is true, then the differences should be consistent for P and possibly Po and/or So. If both (b) and (c) are true, the effects should be seperable. These effects may then be removed by a deconvolution of the observed signals with the empirically determined impulse responses of the lithosphere and hydrophone/cable. Determination of these responses to a level of statistical signifigance will require the recording and analysis of a variety of signals at assorted azimuths and epicentral distances which have strong S/N. Evidence exists to suggest that at least (c) is true.

Figure 4 shows amplitude differences observed across WBHA for a 10 minute section of record which includes a P, Po, and So signal. The upper curve is the absolute value of the maximum difference in amplitude observed between the six hydrophone signals as a function of frequency. Energy below about 0.5 Hz is from microseisms while between 0.5 Hz and 20 Hz it is mostly an average of the P, Po, and So. The lower curve shows amplitude differences between two particular hydrophones. Although it may seem unusual to have combined energy from all of these different types of signals, the individual signals, P, Po, So, and noise, exhibit the same

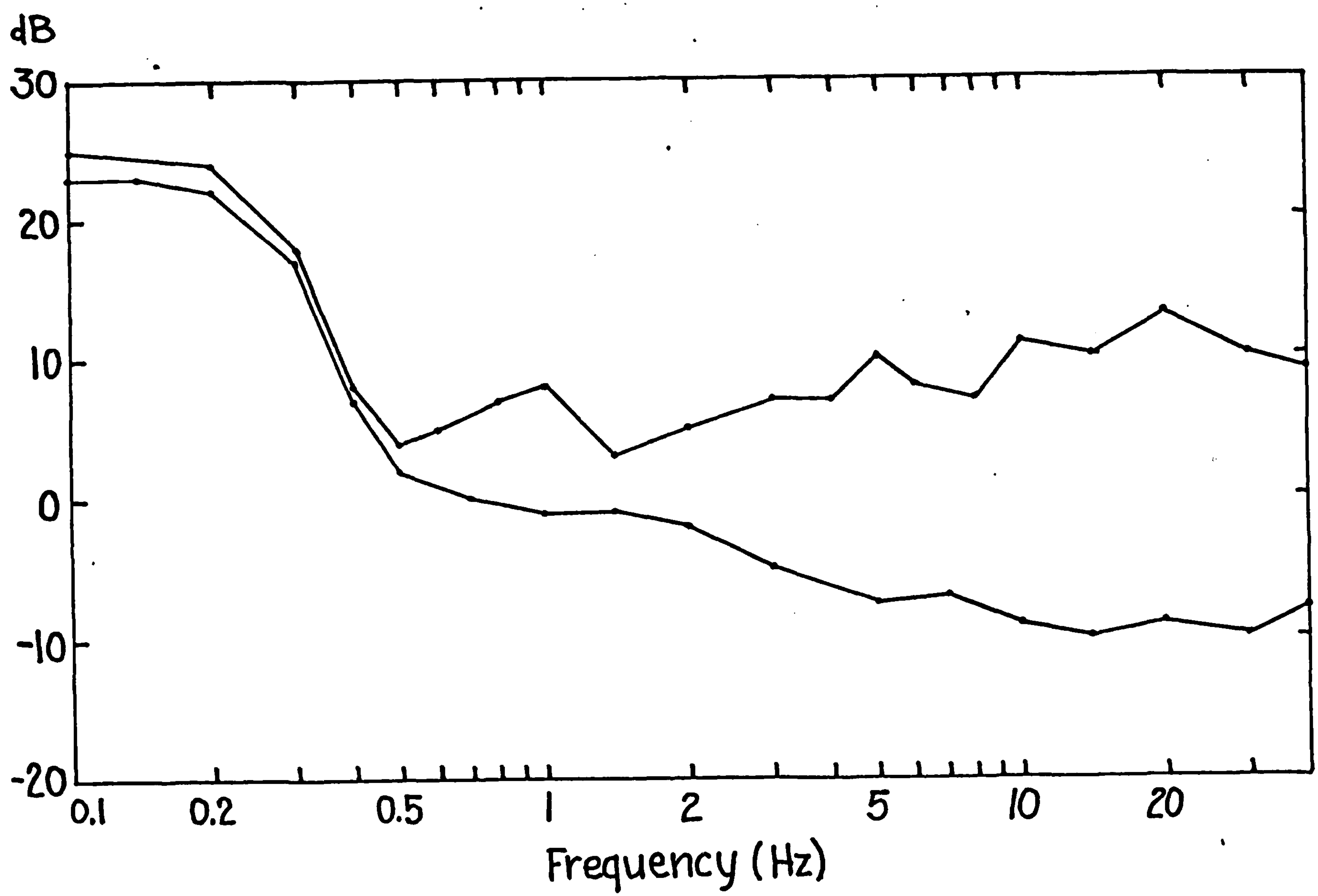

Figure 4. Plot of differences between spectra across the Wake bottom hydrophone array for a 10 minute section of record containing P, Po and So signal and noise. The upper curve shows the maximum value of variation in level between all of the hydrophones. The lower curve shows the difference in level between two of the hydrophones.

relationships although with a somewhat greater scatter. This strongly suggests that there are at least differences in the hydrophone/cable responses which are removable. These differences might easily produce the incoherencies seen in Figure 3. Further and more careful analysis of other events will necessary to precisely determine the differences in amplitude and especially phase. The reward may be stronger coherency and thus an increase in S/N.

Conclusions. The data presented in this report indicate that WBHA, the OSS, and, by inference, the MSS, are seismic tools of comparable quality. Noise levels measured were similar for all three although the data were somewhat limited. S/N ratios measured for OSS were greater than that for individual WBHA hydrophones by an average of about 7 dB. Gains in S/N levels, through stacking of the WBHA signals, will reduce, if not eliminate or reverse, that difference. Precise estimation of the coherence across WBHA will not be made until recently discovered differences in the hydrophone/cable responses have been more accurately determined so that their effects may be removed from the signals.

Many of the comparisons in this report were made via rather indirect routes due to the limited amount of data. Additional data should become available sometime this summer after the OSS recording package has been picked up and the data returned, reduced, and distributed. More data from the August 1981 Wake OBS Experiment will be in a reduced form soon. Also, data from OBS's deployed during the OSS experiment by Oregon State University should be available later this year. All of these future data should be examined and added or compared to those data presented here to

further understand these results.

Acknowledgements. This preliminary and informal report was sponsored by the Air Force Office of Scientific Research, with supplementary funds provided by the U.S. Arms Control and Disarmament Agency. Major upgrading of the Wake system in September of 1982, just prior to the Downhole Experiment, was made possible through the timely support of those agencies.

APPENDIX V

Po/So Phases: Propagation Velocity and Attenuation Across a 1600 Km Long Deep Ocean Hydrophone Array

by

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__Abstract.__ Po/So phases from numerous earthquakes along the margin of the Northwestern Pacific Basin were successfully recorded by a linear, 1500 km ocean bottom hydrophone (OBH) array deployed for two months near Wake Island. Data from ten shallow-focus (<100 km) events at 18° (2000 km) to 33° (3700 km) epicentral distance were used to compute propagation velocities for Po and So. The resulting travel-time equations $T=X/(7.96 \pm 0.05$ km/sec$) - (7.14 \pm 2.38$ sec$)$ and $T=X/(4.57 \pm 0.04$ km/sec$) - (14.03 \pm 5.31$ sec$)$ for Po and So, respectfully, successfully model all Northwestern Pacific Basin shallow-focus Po/So first arrival data collected by the Hawaii Institute of Geophysics since 1963 at epicentral distances greater than 12°. Also, arrivals from an event in the Kuril Islands (mb = 6.6, h = 45 km), which propagated down the axis of the array, were used to estimate the attenuation of Po and So between 25° (2800 km) and 33° (3700 km) epicentral distance. After a correction for cylindrical spreading, values for a frequency dependent Q are found to range from 625 ± 469 at 2 Hz to 2106 ± 473 at 13 Hz for Po and from 1401 ± 296 at 5 Hz to 3953 ± 863 at 15 Hz for So. These same data may be alternatively described as exhibiting an average attenuation of -21.5 ± 0.9 dB per 1000 km of travel path, which applies to both Po and So at all frequencies studied.

Introduction

Late in the summer of 1981, the Hawaii Institute of Geophysics (HIG) successfully deployed a 1500 km long linear array of twelve ocean bottom hydrophones (OBH's) near Wake Island (Fig. 1). Half of the instruments (indicated by open circles) started recording on 12 August and ended on 23 September. The remaining half started on 3 September and ended on 15 October. The total recording time was about 65 days, with all twelve instruments in operation from 3 September through 23 September. Of the twelve OBH's deployed, ten were successfully recovered, and nine of these had quality data throughout their operational period. Recorded concurrently were three bottom hydrophones of the Wake Hydrophone Array (WHA), a 40 km array of sensors located near, and cabled directly to, Wake Island. WHA data were used in the study of first arrivals, and were considered to be part of the OBH array data. All of the OBH and WHA instruments were in ocean depths between 5265 m and 5657 m. Of more than 130 events identified from seismic phases in the recordings, 108 were located by the National Earthquake Information Service (NEIS; Table 1 and Fig. 1). The primary purpose of the experiment was to acquire data of critical importance in understanding a phenomenon known as high-frequency Pn/Sn, long-range Pn/Sn, or Ph.f./Sh.f.; but referred to here as Po/So or Ocean P/Ocean S after Walker (1982).

Po/So phases were first observed in the North Atlantic and have been found throughout the North, Western, and Central Pacific. First arriving Po/So energy travels with a fairly constant apparent velocity (epicentral distance/travel time) of about 8.0 and 4.6 km/sec, respectively, while peak amplitude arrivals have apparent velocities of about 7.6 and 4.5 km/sec, respectively, which are comparable to basal crustal rates. At distances of about 18° ($\cong$ 2000 km), observed frequencies of Po/So are as high as 30 and 35 Hz, respectively; and at distances of of about 30° ($\cong$ 3300 km), as high as 15 and 20 Hz, respectively. The signal/noise ratios for Po/So phases are generally at least ten times greater than the ratios of their respective normal, mantle-refracted P and S phases; and in many instances no P's or S's can be found in spite of the presence of very strong Po's and So's. Aside from the SOFAR channel of the world's oceans, the Po/So waveguide appears the be the earth's most efficient acoustical waveguide. Also, it seems probable that the phenomenon is a dominant feature of all of the world's oceans and marginal seas.

Recent efforts have been made, using synthetics, to determine the mechanism of Po/So propagation (e.g., Stephens and Isacks, 1977; Menke and Richards, 1980; Sutton and Harvey, 1981; and Gettrust and Frazer, 1981), although many essential characteristics of these phases are still poorly known. Data collected before this experiment, composed almost entirely of events recorded at single stations and over an unevenly distributed range of epicentral distances, made difficult the precise determination of the travel-time curve between 0° and 40°, as well as the attenuation of these phases as a function of frequency and distance. These parameters need to be accurately determined so that a unique model can eventually be found.

To exemplify this point consider Fig. 2: a plot of apparent velocity versus epicentral distance for Po and So having Northwestern Pacific travel paths and source focal depths of 100 km or less which is based on data collected and published (Walker, 1981) by HIG before this experiment. Two

Table 1. Events Recorded by the OBH Array
(Data from NEIS Monthly Lists)

No.	Date		Time	Location	h	m	M	n	Po	So
1	Aug.	12	22:35	Solomon Is.	33	4.9	-	3	-	-
2		13	02:57	Tonga Is.	191	5.4	-	3	-	-
3		14	05:42	Volcano Is.	33	4.7	-	3	-	-
4		14	06:24	Molucca Passage	38	5.5	5.3	1	-	-
5		14	09:05	Honshu, Japan	58	-	-	2	-	-
6		15	10:30	Alaska	53	5.1	-	2	-	-
7		15	19:53	Philippine Is.	152	4.8	-	1	-	-
8		16	23:54	Kuril Is.	33	5.6	5.0	3	-	-
9		17	02:17	West Irian	34	5.7	5.8	3	-	-
10		17	17:07	Fiji Is.	383	5.5	-	2	-	-
11		18	05:29	Banda Sea	34	5.1	4.8	1	-	-
12		19	01:41	Kermadec Is.	185	5.1	-	1	-	-
13		19	03:01	Fiji Is.	507	4.8	-	1	-	-
14		19	06:06	Loyalty Is.	25	5.6	4.9	1	-	-
15		20	02:19	Santa Cruz Is.	71	5.0	-	3	-	-
16		20	12:53	Mariana Is.	193	3.8	-	4	-	-
17		20	15:10	Kermadec Is.	347	4.9	-	1	-	-
18		21	14:29	Bonin Is.	509	4.6	-	1	-	-
19		23	01:59	Loyalty Is.	100	5.8	-	1	-	-
20		23	12:00	Kuril Is.	40	6.0	5.8	4	3	3
21		24	15:46	Aleutian Is.	56	5.2	-	2	-	-
22		25	06:56	Honshu, Japan	325	4.8	-	4	-	-
23		25	07:16	Tonga Is.	33	5.9	5.7	1	-	-
24		25	07:22	Tonga Is.	33	5.7	-	1	-	-
25		25	20:07	Mariana Is.	33	4.9	4.4	1	-	-
26		26	04:51	Mariana Is.	40	5.2	5.1	5	-	-
27		26	16:32	New Britain	74	5.7	-	6	-	-
28		26	18:56	Honshu, Japan	230	4.4	-	3	-	-
29		28	09:04	Alaska	71	5.1	-	3	-	-
30		30	11:36	Fiji Is.	609	5.4	-	6	-	-
31		31	06:14	Komandorsky Is.	33	4.7	3.8	1	-	-
32	Sept.	1	07:23	Tonga Is.	33	5.8	5.7	4	-	-
33		1	09:29	Samoa Is.	25	7.0	7.7	6	-	-
34		1	18:38	Tonga Is.	33	5.7	5.3	3	-	-
35		1	23:55	Tonga Is.	33	5.6	5.4	3	-	-
36		2	08:44	Samoa Is.	33	5.3	5.5	1	-	-

Legend: h - event depth (km); m - body-wave magnitude; M - surface-wave magnitude; n - number of instruments in array which recorded body-wave phases P, Po, or So from this event; Po - number of Po arrivals from this event used in first-arrival study; So - number of So arrivals from this event used in first-arrival study.

No.	Date		Time	Location	h	m	M	n	Po	So
37	Sept.	2	09:24	Honshu, Japan	58	5.5	-	2	-	-
38		3	03:59	Hokkaido, Japan	52	4.7	-	4	-	-
39		3	04:29	Philippine Is.	93	5.8	-	4	-	-
40		3	05:35	Kuril Is.	45	6.6	6.6	10	6	8
41		3	19:39	Honshu, Japan	44	5.6	5.4	4	-	-
42		3	19:44	New Guinea	136	4.8	-	5	-	-
43		4	11:15	Philippine Is.	645	6.0	-	10	-	-
44		4	23:44	Solomon Is.	38	5.4	5.3	9	-	-
45		6	11:02	Loyalty Is.	31	5.9	6.2	1	-	-
46		7	15:11	Fiji Is.	231	5.2	-	3	-	-
47		7	16:20	Honshu, Japan	440	4.9	-	3	-	-
48		7	19:06	Honshu, Japan	33	5.8	5.5	7	6	5
49		7	20:07	Honshu, Japan	29	5.1	4.7	7	5	4
50		8	19:26	Kuril Is.	46	5.7	5.4	5	-	3
51		10	03:29	Solomon Is.	110	4.9	-	3	-	-
52		10	23:21	Mariana Is.	13	5.6	5.2	10	5	-
53		11	08:33	Fiji Is.	554	5.2	-	5	-	-
54		12	03:40	Fiji Is.	302	5.2	-	3	-	-
55		12	07:15	Kashmir	33	6.2	5.9	3	-	-
56		12	14:51	Hokkaido, Japan	111	4.9	-	7	-	-
57		12	16:14	Bonin Is.	33	4.6	-	2	-	-
58		13	01:20	Honshu, Japan	39	4.8	4.8	4	-	-
59		13	02:17	Eastern Kazakh	0	6.0	4.5	4	-	-
60		13	20:24	Honshu, Japan	87	4.9	-	3	-	-
61		14	15:08	Honshu, Japan	33	5.4	5.0	4	4	-
62		15	14:12	Banda Sea	102	5.9	-	2	-	-
63		15	20:43	Taiwan	167	4.9	-	3	-	-
64		17	06:19	Banda Sea	33	5.7	5.8	1	-	-
65		17	08:23	Loyalty Is.	30	5.7	6.6	2	-	-
66		17	12:42	Fiji Is.	356	5.2	-	10	-	-
67		17	21:12	Kamchatka	33	4.9	3.9	2	-	-
68		19	07:27	China	561	4.4	-	3	-	-
69		20	04:39	Honshu, Japan	33	4.4	-	2	-	-
70		22	06:55	Mariana Is.	33	4.2	-	6	-	-
71		24	17:20	Bonin Is.	33	5.7	5.3	5	3	2
72		25	03:25	New Guinea	116	4.8	-	1	-	-
73		25	10:21	Bonin Is.	33	4.4	-	2	-	-
74		25	14:30	Kermadec Is.	45	5.9	5.9	5	-	-
75		25	15:01	Honshu, Japan	25	5.5	6.1	2	-	-
76		28	03:36	Honshu, Japan	31	5.5	5.3	5	-	-
77		28	17:56	Kermadec Is.	323	6.0	-	5	-	-
78		29	23:02	Tonga Is.	226	5.1	-	5	-	-

Legend: h - event depth (km); m - body-wave magnitude; M - surface-wave magnitude; n - number of instruments in array which recorded body-wave phases P, Po, or So from this event; Po - number of Po arrivals from this event used in first-arrival study; So - number of So arrivals from this event used in first-arrival study.

No.	Date		Time	Location	h	m	M	n	Po	So
79	Sept.	30	07:04	New Guinea	123	5.4	-	4	-	-
80		30	23:03	Pacific Ocean	10	5.9	5.2	2	-	-
81		30	23:37	Hokkaido, Japan	52	4.9	4.9	2	-	-
82	Oct.	1	12:14	Novaya Zemlya	0	5.9	3.8	4	-	-
83		1	13:10	New Ireland	85	5.0	-	2	-	-
84		1	16:02	Kermadec Is.	33	5.6	5.1	5	-	-
85		1	17:04	Kuril Is.	33	5.9	5.7	5	4	4
86		1	19:00	S. Nevada	0	4.9	-	2	-	-
87		2	05:51	Savu Sea	109	4.6	-	4	-	-
88		2	15:13	Mariana Is.	113	5.0	-	5	-	-
89		3	07:21	Kuril Is.	75	5.1	-	4	-	-
90		3	08:26	Hokkaido, Japan	62	4.4	-	2	-	-
91		3	16:48	Philippine Is.	238	5.0	-	2	-	-
92		4	00:01	New Guinea	33	5.9	6.3	4	-	-
93		4	04:11	Honshu, Japan	38	5.2	5.0	4	-	2
94		4	10:18	Solomon Is.	58	5.1	-	2	-	-
95		4	10:27	Solomon Is.	24	5.7	5.4	5	-	-
96		5	04:28	China	534	4.7	-	2	-	-
97		6	07:40	Aleutian Is.	23	5.2	4.3	3	-	-
98		7	03:02	Fiji Is.	620	5.8	-	5	-	-
99		7	08:32	Solomon Is.	41	5.8	5.3	5	-	-
100		7	15:03	Samoa Is.	33	4.8	-	2	-	-
101		7	17:48	Philippine Is.	595	5.3	-	4	-	-
102		9	12:19	Solomon Is.	50	6.0	6.4	5	-	-
103		9	19:46	Mariana Is.	96	4.7	-	5	-	-
104		11	00:36	Minahassa Pen.	94	5.6	-	4	-	-
105		13	15:53	Kamchatka	112	5.3	-	3	-	-
106		14	12:29	Mariana Is.	205	5.0	-	5	-	-
107		14	20:09	Mariana Is.	131	4.9	-	5	-	-
108		15	01:47	Honshu, Japan	47	6.0	5.4	5	-	-

Legend: h - event depth (km); m - body-wave magnitude; M - surface-wave magnitude; n - number of instruments in array which recorded body-wave phases P, Po, or So from this event; Po - number of Po arrivals from this event used in first-arrival study; So - number of So arrivals from this event used in first-arrival study.

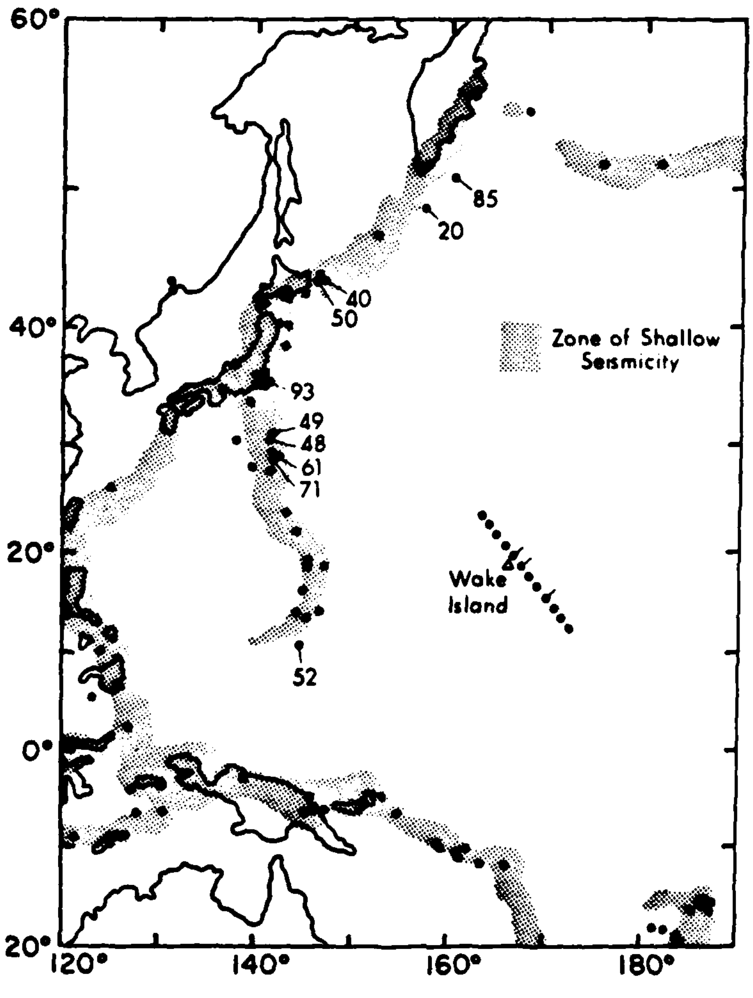


Figure 1. Map showing OBH locations and epicenters of earthquakes recorded by the array (see Table 1). Instruments operating from 12 August through 23 September are indicated by open circles. Those operating from 3 September through 15 October are indicated by closed circles. Three instruments which did not work properly are flagged. Event numbers (from Table 1) are indicated for epicenters of events specifically used in this study.

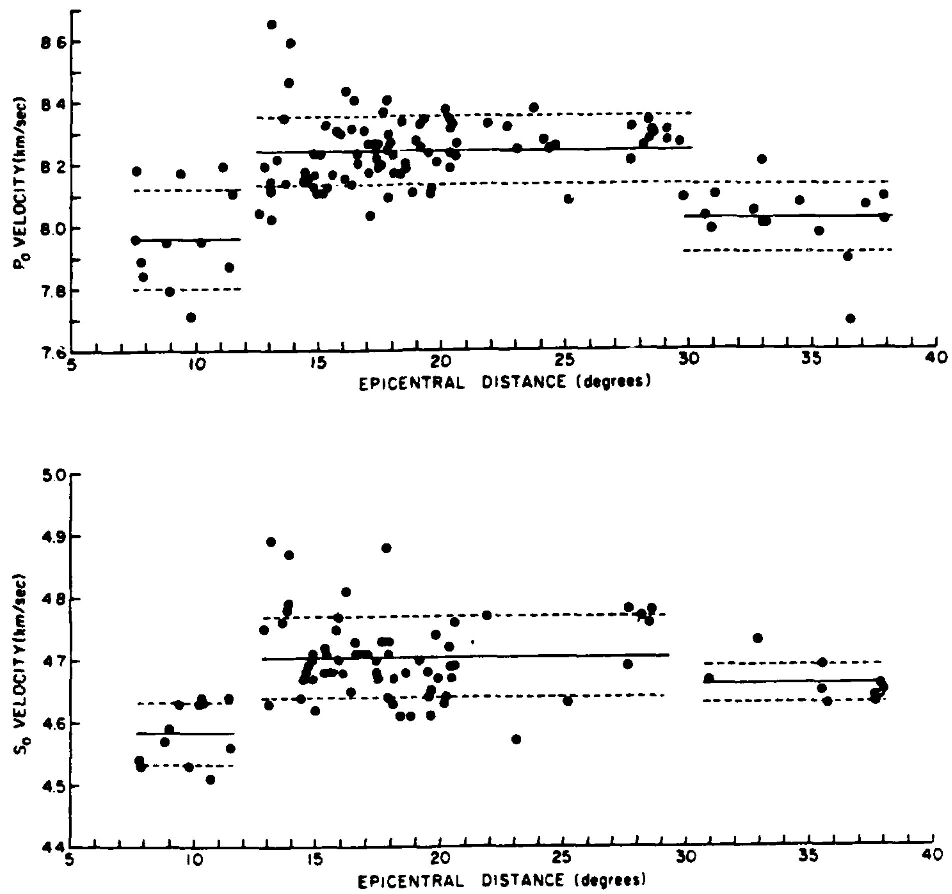


Figure 2. Apparent velocity (X/T) versus epicentral distance (X) for Po and So with Northwestern Pacific travel paths and focal depths of 100 km or less. Note the discontinuities at 12° and 30°. Solid and dashed lines represent the mean apparent velocity plus and minus one standard deviation over the three distance ranges. This plot is based on data compiled before the OBH experiment.

significant features of this plot are the lower apparent velocity values at distances less than 12° and greater than 30° in comparison to values within the 12° to 30° range. The large amount of scatter coupled with insufficient sampling near 12° and 30°, however, make the exact nature of these velocity transitions unknown. For the purpose of modeling, it is important to know if these transitions are smooth or abrupt, and might therefore represent a gradual increase in velocity with depth or a discontinuity in velocity at some depth.

Similar difficulties arise when attempting to use older data to estimate the attenuation of Po/So energy as a function of travel-time (or distance). The high frequencies and large signal/noise ratios observed would indicate that their attenuation must be significantly smaller than that of normal, mantle-refracted P or S phases at similar distances. However, these observations might also be due in part to a frequency-dependent Q combined with low noise levels at the higher frequencies (> 4 Hz) where Po/So are most prominent. Unfortunately, the mix of data (i.e., different earthquakes recorded at only single stations) make it hard to separate attenuation from other factors which influence the observed amplitudes such as magnitude, focal depth, epicentral distance, source orientation, and possibly azimuth.

To help clarify these uncertainties, an experiment was designed to record Po/So across a linear, 1500 km array consisting of 12 OBH's. The data provided by such an experiment would permit determination of Po and So phase velocities independent of the source parameters, thus hopefully eliminating the major source of scatter in velocity estimates. Data from the experiment would also facilitate a nearly direct measure of attenuation as a function of frequency and travel-time (only a spreading term would have to be assumed in order to determine the apparent Q). In addition, any other changes in the Po/So coda would for the first time be observed at several distances along approximately the same azimuth.

The array was aimed towards northern Japan and the southern-most islands of the Kuril chain (Fig. 1), and was positioned to provide data across the 30° transition zone previously described. This target was chosen because of its long history of moderate-to-large earthquakes and several successful recordings of Po/So phases from this region on the hydrophone installation at Wake Island. Of the events recorded by the OBH array in the Marianas through Kuril portion of the circum-Pacific arc, the largest (a 6.6 mb; event 40 in Table 1) occurred in the target area while all of the instruments were recording.

Po/So Propagation and Apparent Velocity

To confirm the assumption that much of the scatter in Fig. 2 can be attributed to errors in the epicenters and/or origin times of these single station data points (i.e., no more than one station recorded any given earthquake), a similar plot has been constructed for some of the OBH data (Fig. 3). Although this data as a whole exhibits scatter of about the same magnitude as that shown in Fig. 2, there is significantly less scatter within each subset of data representing individual events at several OBH's. Thus, the larger source of scatter may be attributed to apparent velocity differences between events; and a strong possibility is that these

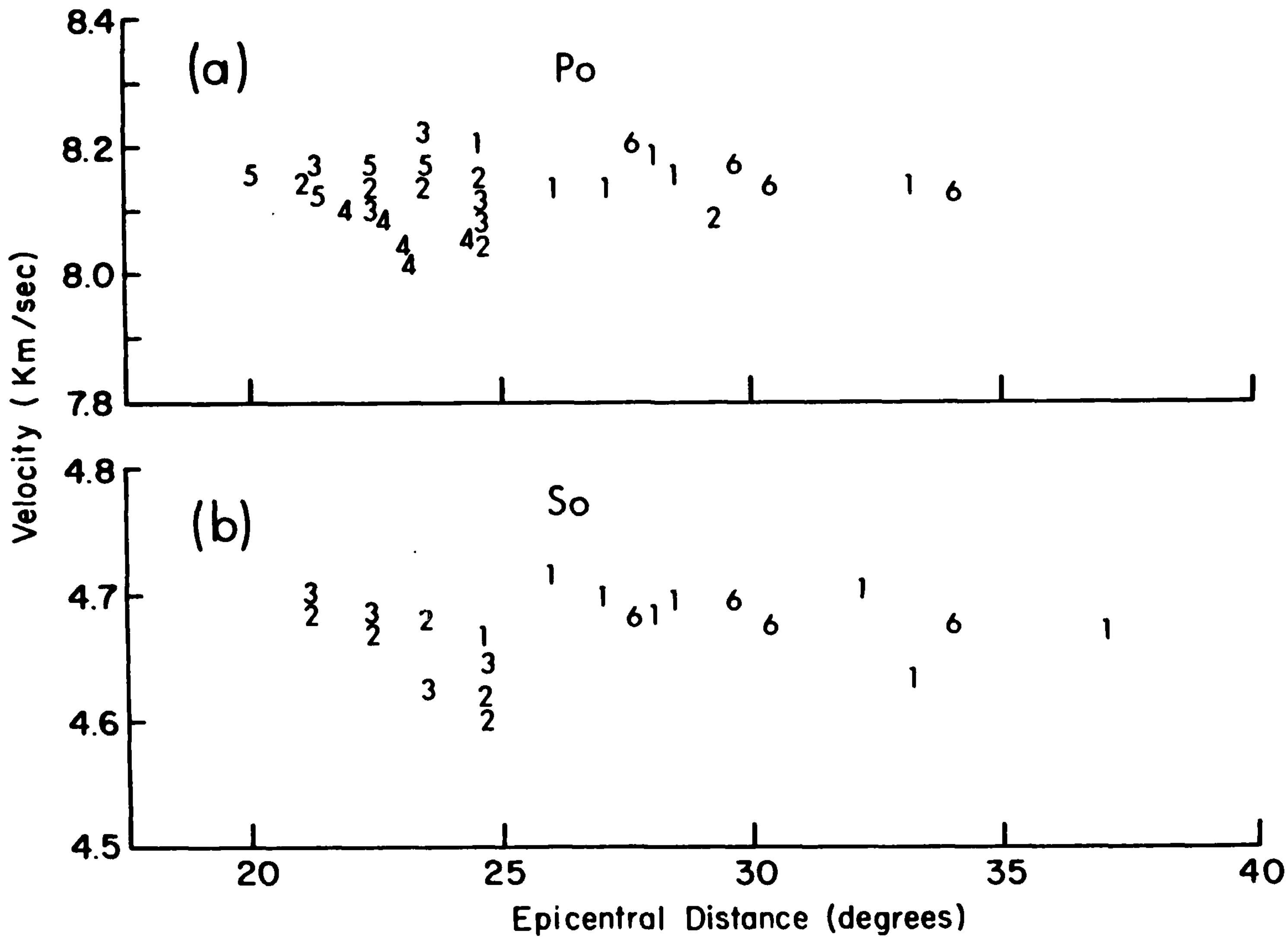


Figure 3. Apparent velocity (X/T) versus epicentral distance (X) for some of the Po and So data collected during the OBH experiment. Data points numbered 1 through 6 represent each set of first arrivals recorded across the OBH array from events 40. 48. 49. 52 61. and 85. respectively. Note that the scatter of each subset is less than the scatter of the combined data.

differences are a result of errors in NEIS origin times and hypocenter locations. The remaining scatter within each subset may be the result of: (1) uncertainty in the time of onset, (2) OBH location errors, (3) OBH clock correction errors, and/or (4) local differences in crustal and sediment structure between OBH's. Unfortunately, the magnitude of this remaining scatter is enough to cause an unacceptable level of uncertainty in the propagation velocity of Po or So for any given event. An uncertainty of 1 sec in travel-time over 500 km of the array at a phase velocity of 8.0 km/sec will produce an uncertainty of 0.13 km/sec in the determination of that phase velocity, as well as an uncertainty of 5.0 sec in the travel-time intercept for data taken at an average epicentral distance of 2500 km. To reduce this uncertainty, a method was sought to determine propagation velocity and travel-time intercept by combining the first arrival data of all the events in a way which would have the following important properties: (1) propagation velocity would be determined from the differences in travel time between OBH's for a given event and would be independent of the NEIS origin time published for the event; (2) events recorded on more instruments would be weighted more heavily; (3) events recorded over a larger range of epicentral distance would also be weighted more heavily; and (4) the travel-time - epicentral distance relationships within the data set of each individual event would be maintained. The following method satisfactorily meets those requirements.

Using only those events with focal depths of 100 km or less, having Northwestern Pacific Basin travel paths, and recorded with distinct onsets *at two or more stations* (see Table 1), the raw epicentral distance and travel time data were computed using NEIS epicenters. For each subset of data associated with a single event, the mean epicentral distance and travel time was computed and subtacted from the raw data for that event to yield zero-meaned data for each event, as well as for the data as a whole. From these combined data the slope of the travel-time line could be computed, but the intercept would be lost (it would be exactly zero). Consequently, the mean for all of the raw epicentral distance and travel-time data was computed and added to each point of the zero-meaned data set to restore the intercept. The travel-time lines computed from these data, and shown in Fig. 4, represent the best available estimates of Po/So velocities at distances between about 2400 and 3400 km. These values (i.e., inverse slopes) are 7.96 ± 0.05 km/sec and 4.57 ± 0.04 km/sec for Po and So, respectively. The large negative intercepts found, -7.14 ± 2.38 sec and -14.03 ± 5.31 sec for Po and So respectively, imply that the first arriving energy propagates at a higher velocity than indicated by the inverse slopes over some portion of the travel path nearer to the source than where the observations were made.

In Fig. 5, we have superimposed Po/So data from the Wake OBH experiment (solid triangles) on Fig. 2. It is obvious that these data do not support the discontinuity in apparent velocity at 30° which was a feature of the older data; but they appear, instead, to describe a smooth transition across this boundary. A re-examination of the older data, especially those data points near the offset, was made to determine if the cause of this discrepancy could be found. Consequently, the original computer cards used to calculate epicentral distances for data collected in 1963 and 1964 were found to contain systematic errors in the coordinates of some recording sites. The formerly classified status of these sites and

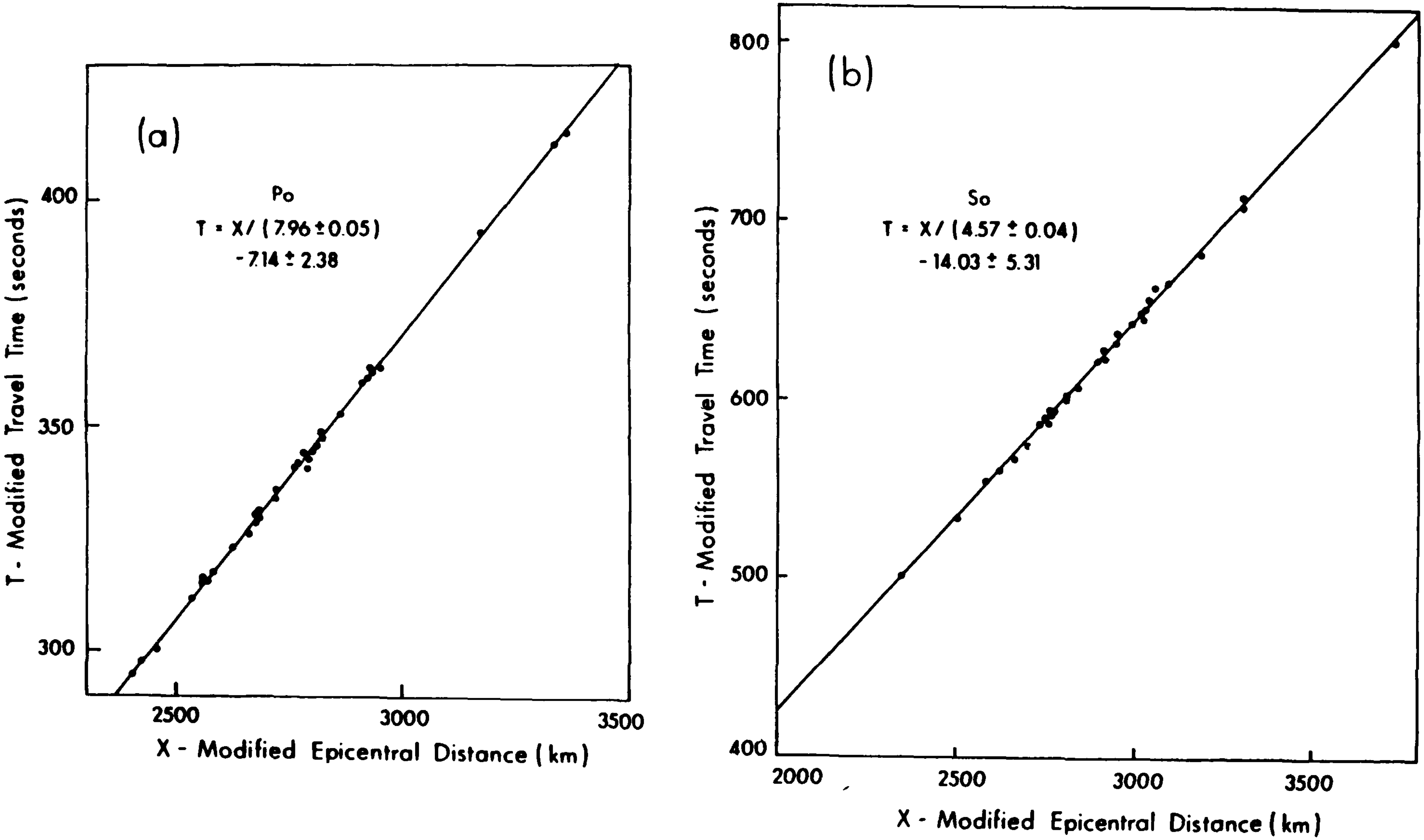


Figure 4. Modified travel-time plots for Po and So as described in the text.

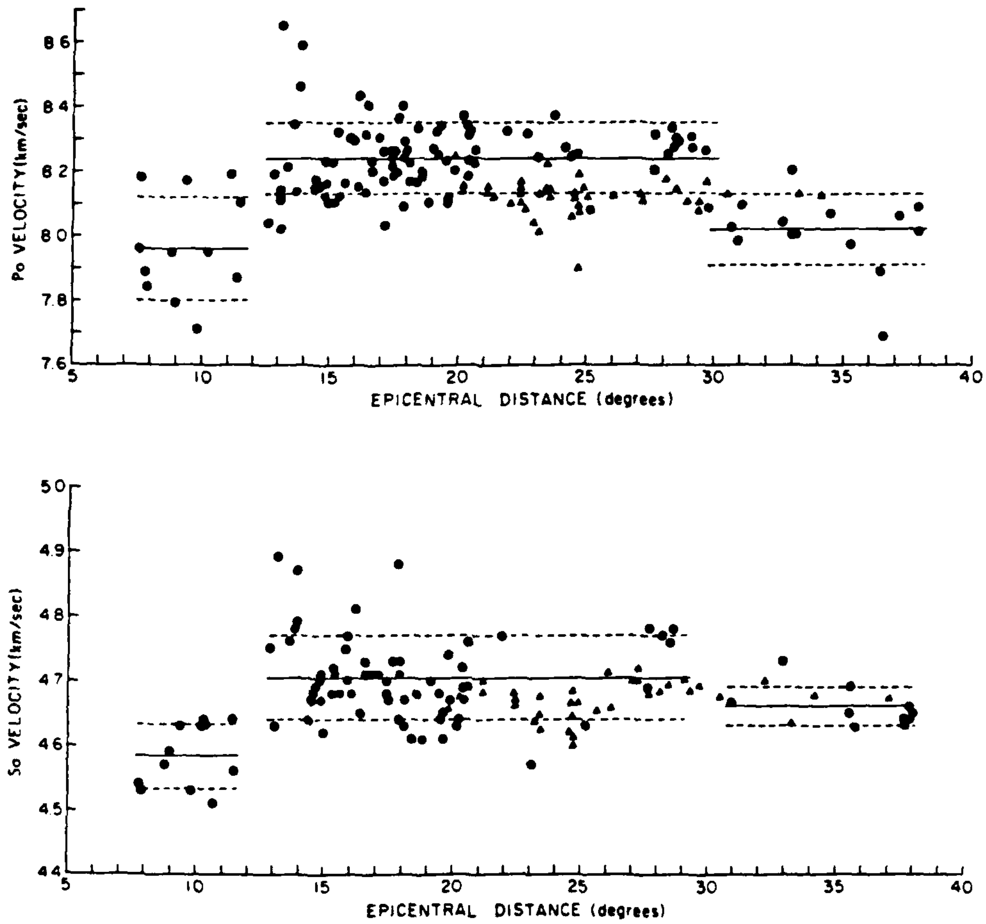


Figure 5. Po and So data from the OBH experiment (solid triangles) superimposed on Fig. 2a and Fig. 2b, respectively. Note that these data do not support a discontinuity in apparent velocity at 30°.

the circuitous route by which these coordinates had been previously obtained may be an explanation for these errors. The erroneous data have been plotted as open circles and the corrected data as solid circles (along with the rest of the older data) in Fig. 6. Also plotted in Fig. 6 (as open triangles) are some additional hydrophone data from the analog cassette recording system at Wake, collected since 1978. It is clear from this comprehensive data set that an apparent velocity discontinuity at 30° is no longer supported by the data. Instead, a gradual decrease of apparent velocity with distance is observed between about 12° and 38° for both Po and So. This characteristic of apparent velocity is entirely compatable with the inverse slope propagation velocity and intercept values computed from the OBH data and shown in Fig. 4.

To illustrate this compatability, the travel-time equations have been converted into relationships between apparent velocity and epicentral distance as follows:

$$T = X/V + I$$

Travel-time equation where T is travel-time, X is epicentral distance, V is propagation velocity, and I is the travel-time intercept.

$$A = X/T = X/(X/V + I)$$

Apparent velocity equation where A is the apparent velocity.

$$S_A^2 = \frac{(X/V+I)^2 V^4 S_X^2 + X^4 S_V^2 + X^2 V^4 (S_I^2 + S_O^2)}{V^4 (X/V+I)^4}$$

Mean-squared error in apparent velocity, S_A^2, resulting from errors in: the propagation velocity, S_V; the travel-time intercept, S_I; the epicentral distance, S_X, due to epicenter errors; and the observed travel-time, S_O, due to errors in origin-time.

Plotted in Fig. 7 are A, and $A \pm S_A$ versus epicentral distance, X. Values for V, S_V, I, and S_I are those given in Fig. 4; S_X is 10 km; and S_O is 1 sec. Values used for S_X and S_O are reasonable for epicenter/origin-time data taken from the NEIS listings, and these lists have been used for all of the data in the figure. The figure shows that approximately one standard deviation of the data (ie. 68 percent for normally distributed

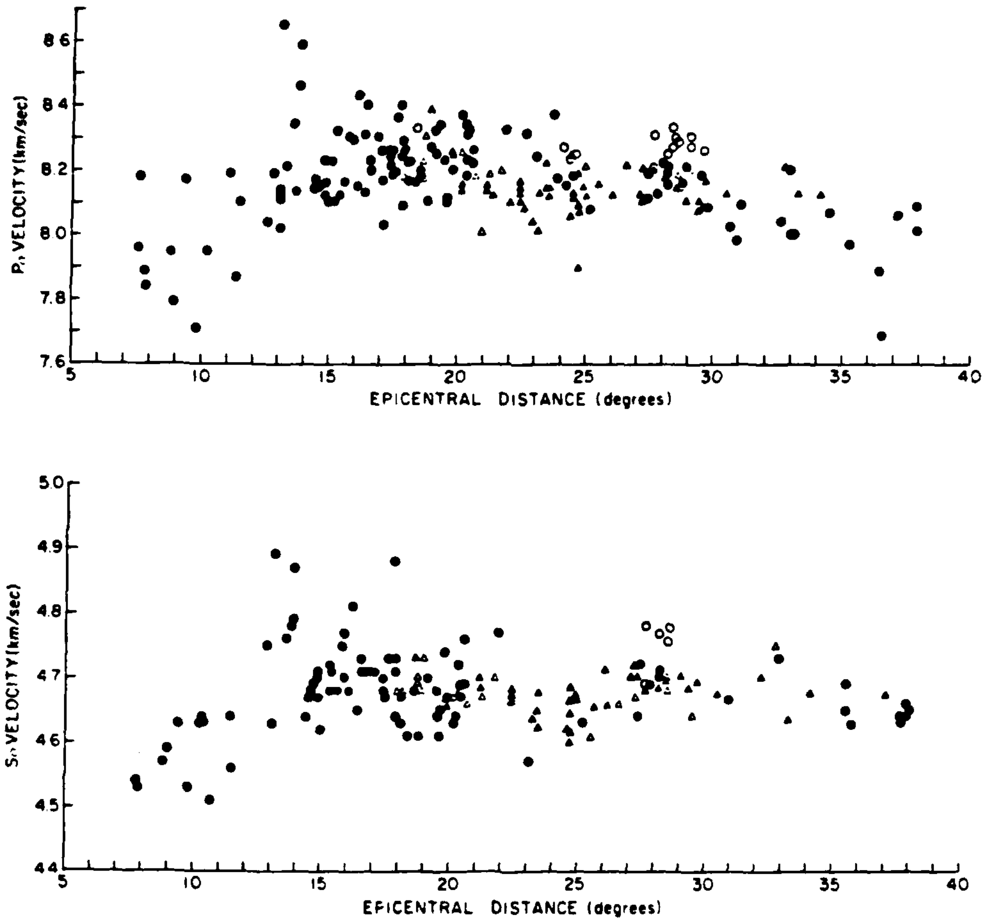


Figure 6. This figure is the same as Fig. 5 except that: (1) erroneous data from 1963 and 1964 (open circles) have been replotted as closed circles; and (2) addition hydrophone data from Wake. collected since 1978. are plotted as open triangles.

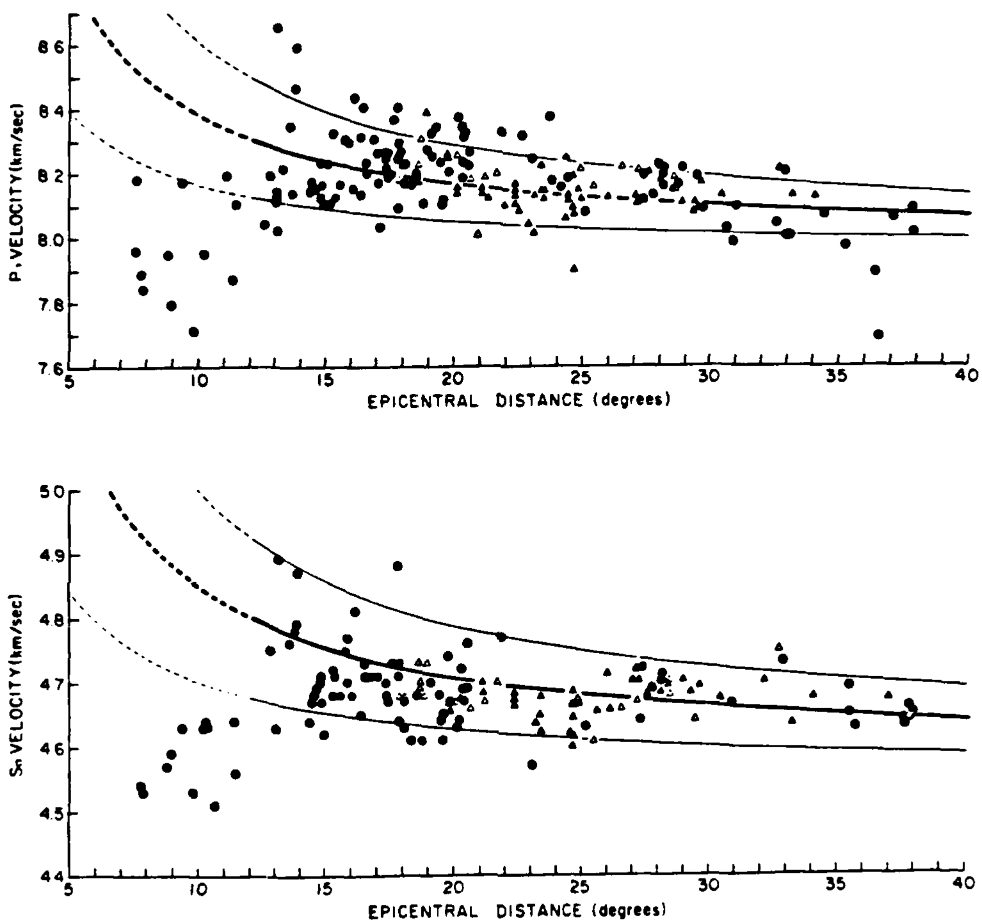


Figure 7. This figure contains the data from Fig. 6. representing all of the Po and So first arrival data from shallow-focus events with Northwestern Pacific Basin travel paths collected by HIG since 1963. Superimposed on these data are curves representing the Po and So travel-time equations (Fig. 4). with plus and minus one standard deviation. determined strictly from the OBH data.

Note that most of the data beyond 12° epicentral distance falls within the bounds described by these curves.

data) falls within the bounds of A S_A. It is concluded, therefore, that the first arrival times of Po and So phases from shallow-focus (i.e., focal depths less than 100 km) earthquakes occuring along the margin of the Northwestern Pacific Basin with travel paths greater than 12° epicentral distance across the Northwestern Pacific Basin, may be successfully modeled by the travel-time equations given in Fig. 4.

An important question which remains to be answered is: By what methods of generation and propagation are the first arrivals on both sides of the 12° apparent velocity discontinuity produced? In spite of those modeling efforts mentioned previously, which have successfully reproduced certain aspects of Po/So travel-time and coda, no model as yet exists which addresses this question or reproduces the observations which led to this question. A hypothesis proposed here, which seems to contain some credibility, is that energy observed at less than 12° has propagated from near the source to near the receiver entirely within the waveguide (i.e., up the descending lithosphere and across the plate), while first-arriving energy observed at greater than 12° has propagated along a higher velocity, or deeper, P or S type path over distances less than 12° before coupling into the waveguide at a distance greater than 12°. (The term "waveguide" refers here to the structure within which Po/So energy propagates at the constant velocity value given in Fig. 4.) Evidence which supports this hypothesis is: (1) the apparent velocity data observed for Po and So at distances less than 12° could reasonably be fit by a zero-intercept linear travel-time equation with a propagation velocity equal to the propagation velocity found for the data beyond 12° (This would imply that the propagation velocity and thus the structure of the waveguide are continuous across 12° - an intuitively pleasing result.); and (2) the apparent velocities for shallow-focus P and S at 12° (from Jeffreys and Bullen, 1958) are near those required for P and S to couple into the Po/So waveguide and produce the observed arrival times beyond 12°. Although a propagation mechanism of this type might fit the data quite well, a velocity model of the oceanic crust and upper mantle which produces this phenomena has not been found. It is probable that such a velocity model would contain lateral heterogeneities associated with the downgoing slab in order to propagate energy between 0° and 12° with an average velocity greater than the waveguide velocity, and still couple this energy into the waveguide. This requirement is not easy to satisfy (and may be impossible to satisfy) with a radially symmetric velocity model.

One test of this proposed hypothesis could be made by examining Po/So arrivals from earthquakes with depths greater than 100 km. Po/So energy has been observed and recorded by HIG for many earthquakes with focal depths greater than 100 km and up to 600 km. Energy which has propagated along a P or S type path before coupling into the waveguide should contain a depth dependence in travel-time, coda, and/or frequency content. The precise nature of such a dependance would serve to either confirm or deny the hypothesis, or to generate a new one.

Attenuation of Po and So

As stated earlier, one of the more remarkable features of Po/So is their high-frequency content; therefore, a major goal of Po/So research in recent years has been to quantify those properties within the earth in terms of Q which permit the efficient transmission of these frequencies over great distances. When a frequency-independent model for Q was fit to some older Po/So data with frequencies between about 2 and 10 Hz, the resulting Q values were greater than 5000 in most cases (Walker et al., 1978 and Sutton et al., 1978). These values are much higher than those generally found for upper mantle travel paths using P and S data at frequencies below 2 or 3 Hz. A frequency-dependent Q, however, might satisfy both sets of observations. Sutton et al. (1983) found two methods for extracting a relationship between Q and frequency from single-station Po/So data. They found that Q was approximately proportional to frequency over the range 2-9 Hz and that the Q of So was higher than the Q of Po for any given frequency.

Data collected during the OBH experiment provided, for the first time, the opportunity to observe Po/So energy propagating across a large array of instruments. Although Po/So phases from numerous events were recorded, the magnitude 6.6, Kuril Is. event noted earlier (event 40, Table 1) was especially well suited for a study of attenuation. Its large magnitude and its location in the area targeted by the array produced Po/So phases which travelled down the axis of the 1500 km deployment line with sufficient energy to be observed with high signal/noise ratios on many of the instruments.

Fig. 8 shows the spectra of the Po and So coda from the Kuril event at five epicentral distances corresponding to the five OBH's that were used. These spectra have been computed from a series of contiguous 512 point FFT's taken on the time series data which was digitized at 80 samples per sec. The spectral energy has been summed over an apparent velocity window extending from 8.2-7.0 km/sec and from 4.7-4.0 km/sec for Po and So, respectively, and has also been summed over a 1 Hz band at any given frequency. Instrument response has not been removed; however, the response of each individual OBH is presumed to be identical so that intercomparison of the spectra is valid. Only signal levels which were at least 4 dB above background noise levels, at any given frequency, have been plotted. A correction for cylindrical spreading has also been applied to these spectra so that the losses observed in the figure represent attenuation due to anelasticity, scattering, tunneling, and/or any mechanism other than cylindrical spreading. Note that in general the energy level falls off at a constant rate with distance, regardless of frequency. Also note that the attenuation of So with distance is about the same as that for Po.

A general expression for the observed amplitude of seismic signals of this type is:

$$A(f) = A_0(f) r^{-b} e^{-\pi f p q(f)[r-1]}$$

where $A(f)$ is the observed signal amplitude at a given frequency,
$A_0(f)$ is the source amplitude ($r=1$) at a given frequency,
f is the given frequency,

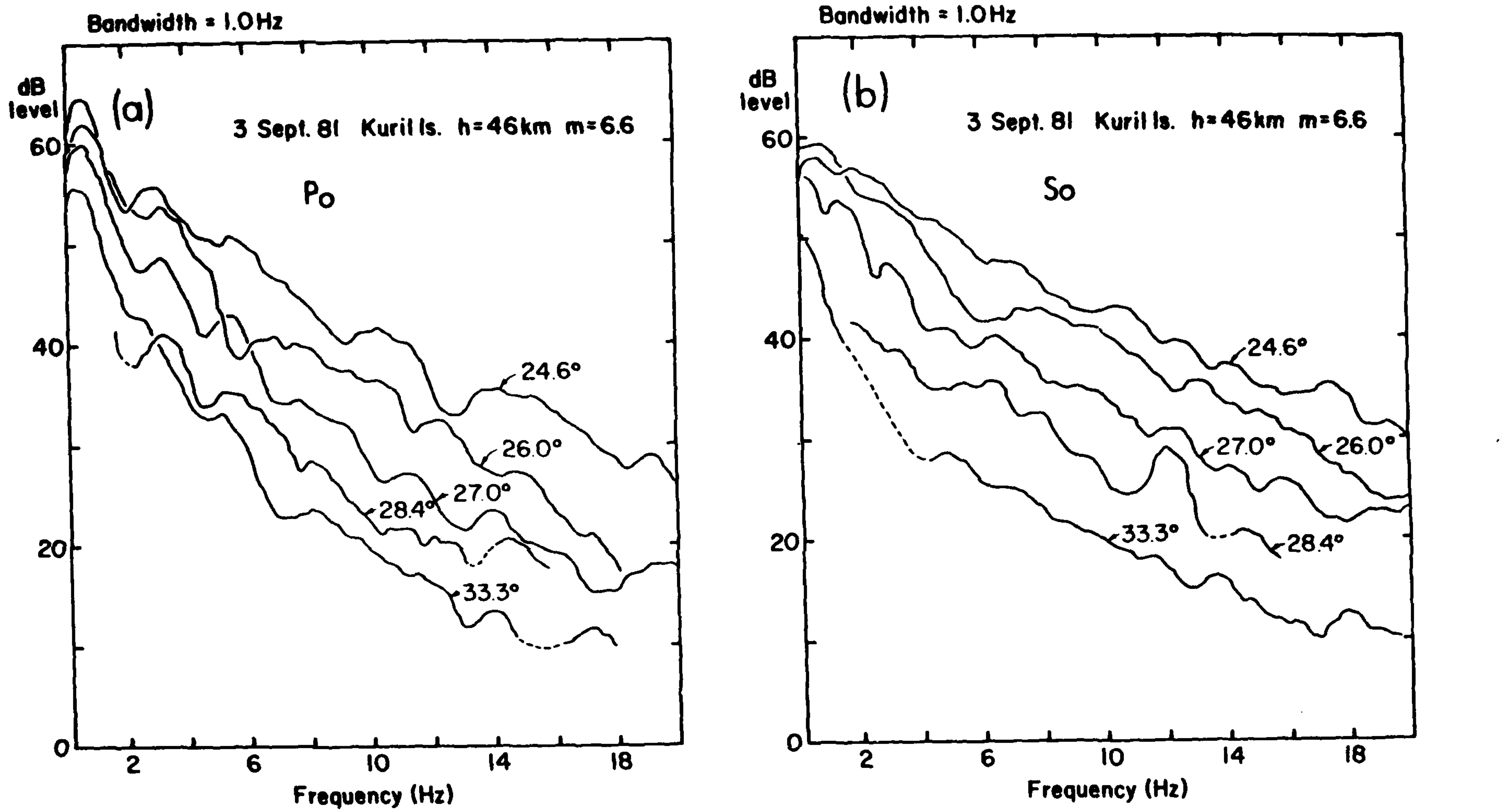


Figure 8. Spectra of Po and So from a large event in the Kuril Is. observed at five epicentral distances corresponding to five OBH's. Spectral energy has been summed over the apparent velocity ranges 8.0 - 7.2 km/sec and 4.7 - 4.0 km/sec for Po and So. respectively. The effect of cylindrical spreading. amounting to only 1.3 dB between 24.6° and 33.3°. has been removed from the data. Only signal levels at least 4 dB above ambient noise levels have been plotted. Dashed portions of the spectra are for continuity only. and do not represent actual data at those frequencies.

r is the epicentral distance,
b is the spreading parameter (0.5 for cylindrical spreading; 1.0 for spherical spreading),
p is slowness (i.e., travel-time/epicentral distance),
and $q(f) = Q(f)^{-1}$ is the apparent anelastic attenuation coefficient.

Conversion of the observed amplitude into decibels gives:

$$20\log_{10}A(f) = 20\log_{10}A_0(f) - 20b\log_{10}(r) - 20\pi fpq(f)[r-1]\log_{10}(e)$$

Rearranging terms and differentiating with respect to r gives:

$$\frac{d(20\log_{10}A(f) + 20b\log_{10}(r))}{dr} = -20\pi fpq(f)\log_{10}(e)$$

Therefore:

$$Q(f) = q(f)^{-1} = \frac{-20\pi fp\log_{10}(e)}{\frac{d(20\log_{10}(A(f)r^b))}{dr}}$$

Each curve plotted in Fig. 8 represents $20\log_{10}[A(f)r^{0.5}]$ at a given r for a range of frequencies. At any given frequency, we know $20\log_{10}[A(f)r^{0.5}]$ at several r's and can thus determine $\frac{d\{20\log_{10}[A(f)r^{0.5}]\}}{dr}$ by simple linear regression. All other quantities in the equation for Q(f) are known. Q(f) has thus been found for data sampled in one Hertz bands, and these values are plotted in Fig. 9. Although cylindrical spreading (b = 0.5) has been assumed, the spreading term plays only a minor role in these calculations. A choice of spherical spreading would raise the values of Q(f) by no more than about 10 percent. Only frequencies where data exist at all five distances have been used. The standard deviations shown include contributions from the error in the determination of $\frac{d\{20\log_{10}[A(f)r^{0.5}]\}}{dr}$, the error in slowness which is due to sampling the data over a range of slownesses, and the error in frequency due to sampling over a 1 Hz band. This method gives values for Q(f) roughly proportional to frequency, and gives higher values of Q(f) for So relative to those for Po at any given frequency. These results are consistent with those found by Sutton et al. (1983) mentioned earlier, although the absolute levels for Q(f) are lower at any given frequency in this study. The relationship between the Q(f) values of Po and So, $Q_\beta(f) >= 1.4Q_\alpha(f)$, is markedly different from the relationship $t^*_\beta = 4t^*_\alpha$, which implies $Q_\beta(f) = 0.44Q_\alpha(f)$, found by others (see for example Cormier, 1982).

The nature of the Q(f) values suggests that a simpler mathematical model might be used to describe the attenuation of Po/So. This is because

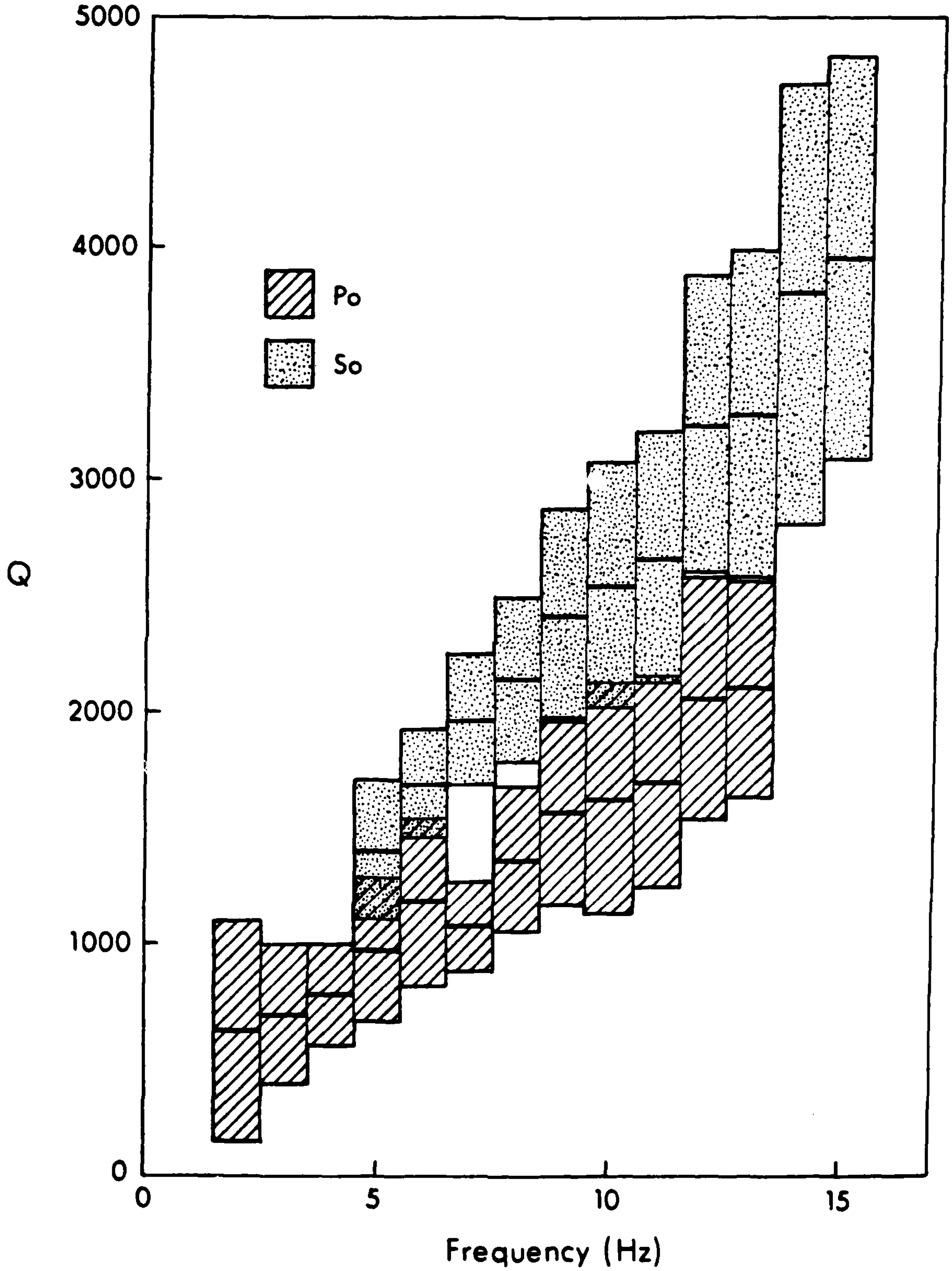


Figure 9. Values for Q(f) plus and minus one standard deviation as explained in the text are plotted versus frequency for both Po and So.

values for fpq(f) are approximately the same for any given frequency and slowness (ie., Po or So). Thus, the form of this model is: $A(f) = A_0(f)r^{-b}e^{-a(r-1)}$, where "a" is the coefficient of attenuation. In this expression, the change in signal amplitude over some propagation distance is not a function of frequency or slowness as in the previous expression containing "q". By a method similar to that described earlier it can be shown that: $-20a\log_{10}(e) = \frac{d\{20\log_{10}[A(f)r^{0.5}]\}}{dr}$, where $-20a\log_{10}(e)$ equals the decibel change in amplitude. after a cylindrical spreading correction, per unit propagation distance. The right-hand side of the above equation may be evaluated by linear regression. using the set of values for $20\log_{10}[A(f)r^{0.5}]$. which can be computed from the observed values for A at a given r (and for a given frequency band), versus r. Values for $-20a\log_{10}(e)$ have been computed and tabulated in Table 2. The same data set used to determine the Q(f) values discussed previously has been used to compute values in the table. With the exception of two lower values for Po at 2 Hz and 3 Hz and the slightly higher average values for Po relative to So, it could be said that the data generally support the assumption that "a" is nearly a constant value for both Po and So at any of the frequencies examined.

All of the data can be combined by a zero-meaning method, similar to that described for combining the first arrival data. to yield a single value for $-20a\log_{10}(e)$. These modified data are shown in Fig. 10. and the regression line fit to them has a slope of -21.5 ± 0.9 dB per 1000 km of travel path. Also shown are regression lines fit to the subsets of Po and So data which have slopes of -19.7 ± 1.4 and -23.6 ± 1.1 dB per 1000 km. respectively. Differences between the Po and So values reflect those differences observed in Table 2. Note that all of the data lie at five distances corresponding to the five OBH's. Also note that the data points at each distance do not cluster about the central regression line. but tend to cluster about some value away from the line. It is possible that these shifts. amounting to a few dB at most. are due to differences between individual OBH responses. These differences may exist because of complexities in processing the slow-speed cassette tapes. and uncertainties in the absolute calibration of the individual hydrophones. Computation of new regression lines. under the assumption that the data of each OBH contain a constant but unknown bias. and under the condition that the sum of the squares of the biases are minimized, results in exactly the same regression lines shown in the figure with somewhat smaller variances. This result is due to the mathematics. and not to any unique property of the data.

Conclusions

Data collected by a 1500 km OBH array deployed for two months in the Northwestern Pacific Basin near Wake Island has provided important new information about the propagation of Po/So phases. Using this array. propagation velocities of first arrivals from shallow-focus (<100 km)

Table 2. Attenuation of Po and So as a Function of Frequency and Propagation Distance

f	Attenuation (dB/1000 km)	
(Hz)	Po	So
2	-11.5 ± 8.4	- -
3	-15.4 ± 6.1	- -
4	-18.5 ± 4.7	- -
5	-18.4 ± 5.6	-22.4 ± 4.3
6	-18.3 ± 5.4	-22.3 ± 2.6
7	-23.4 ± 3.8	-22.3 ± 2.8
8	-21.1 ± 4.6	-23.4 ± 3.4
9	-20.6 ± 5.1	-23.4 ± 4.1
10	-22.1 ± 6.7	-24.7 ± 4.8
11	-23.4 ± 6.0	-25.9 ± 4.9
12	-21.0 ± 5.2	-23.3 ± 4.3
13	-22.2 ± 4.8	-24.8 ± 5.1
14	- -	-23.1 ± 5.2
15	- -	-23.8 ± 5.0

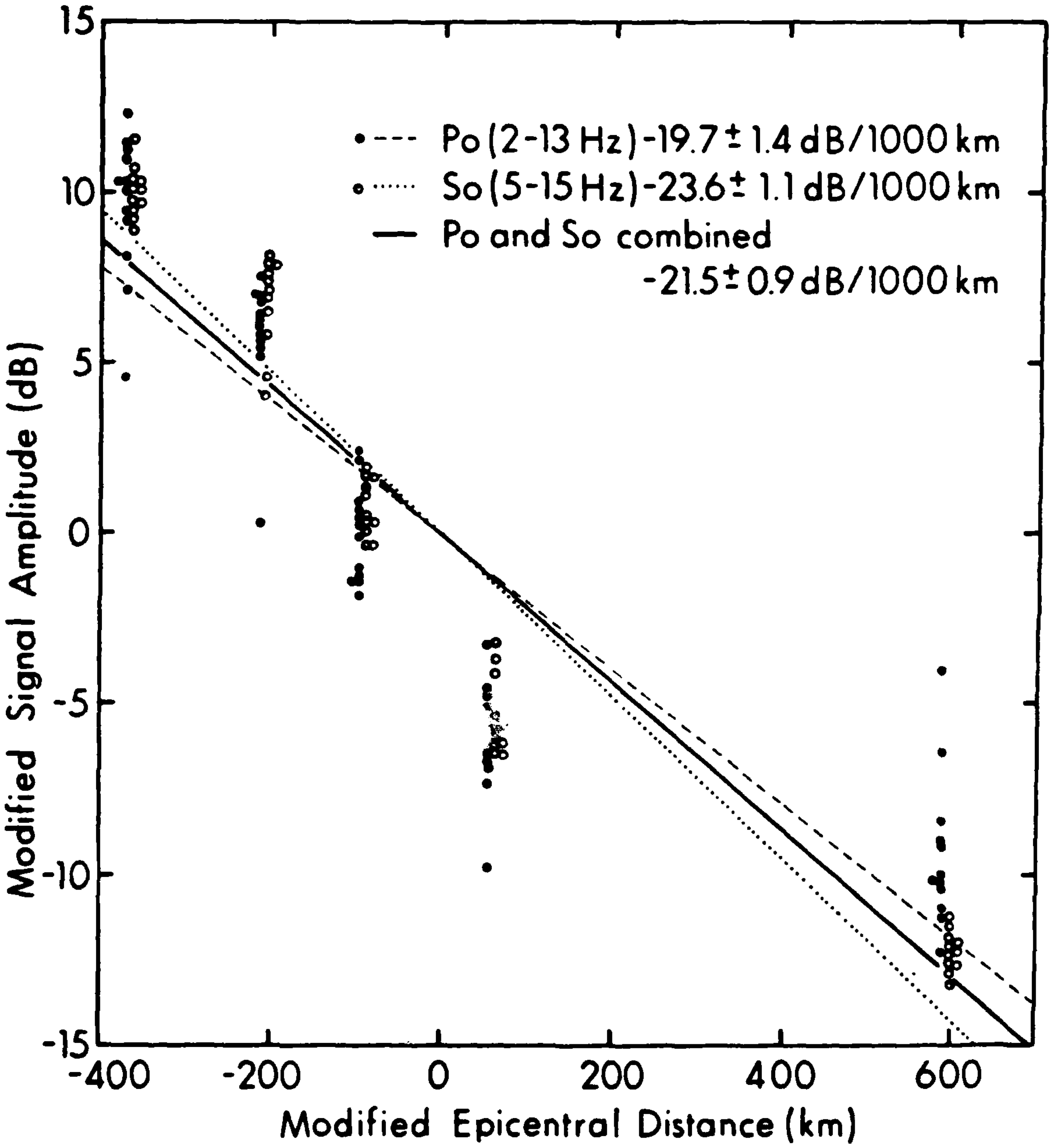


Figure 10. Spectral amplitudes at each frequency studied (Po: 2-13 Hz and So: 5-15 Hz) are plotted versus epicentral distance after modification by zero-meaning as explained in the text. The five data clusters represent the five OBH's used. Note that the data of both Po and So, at all frequencies, follow the same general trend, which is attenuation as a function of distance. For reference, attenuation as a function of distance at each individual frequency in Po and So is listed in Table 2.

events have been measured by a more accurate method than was previously possible using single station data. The velocities found are 7.96 ± 0.05 km/sec and 4.57 ± 0.04 km/sec for Po and So, respectively.

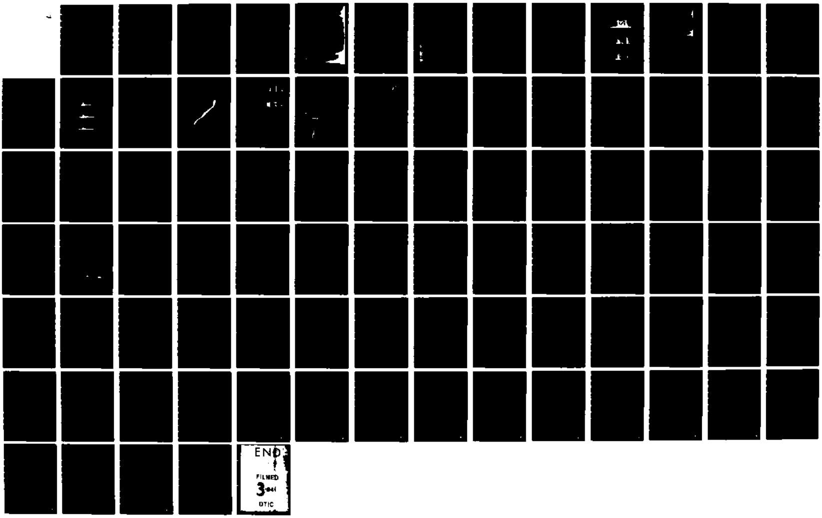
measured at epicentral distances between 18°(2000 km) and 33°(3700 km). Associated with these propagation velocities in the linear travel-time equation are intercepts equal to -7.14 ± 2.38 sec and -14.03 ± 5.31 sec for Po and So, respectively. These large negative intercepts imply higher propagation velocities over some part of the travel path nearer to the source than where the data were recorded. Travel times of all Po/So first arrivals collected by HIG since 1963, from shallow-focus events with

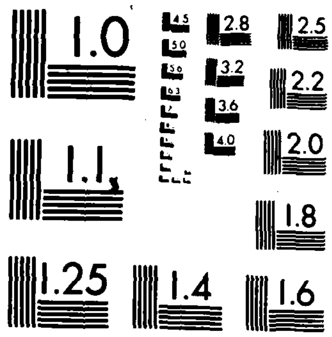
Northwestern Pacific Basin travel paths greater than 12° epicentral distance, are successfully modeled by the linear travel-time equation: $T=X/V + I$, using those values for V (propagation velocity) and I (travel-time intercept) reported here. Data at epicentral distances less

than 12° (collected prior to this experiment) appear to follow a different Po/So travel-time branch than the one described by the OBH data. The exact nature of this branch is not clear due to deficiencies in the quantity and quality of this data. Additional insight into this transition may be found through the examination of Po/So arrivals from numerous deeper-focus events (up to 600 km focal depth) which have been recorded but not yet studied. The OBH data have also been used to directly measure the attenuation of Po and So. An event which occured in the Kuril Islands (mb=6.6, h=45 km) and generated Po and So arrivals which propagated almost exactly down the axis of the array, was used to quantify attenuation in terms of a frequency-dependent Q. Values found for Q(f) range from 625 ± 469 at 2 Hz to 2106 ± 473 at 13 Hz for Po, and from 1401 ± 296 at 5 Hz to 3953 ± 863 at 15 Hz for So. This attenuation may be more simply described in terms of the single value -21.5 ± 0.9 decibels per 1000 km of travel path, which in general applies to all the frequencies studied in both Po and So.

AD-A137 778 SPECTRAL ANALYSES OF HIGH-FREQUENCY PN SN PHASES FROM VERY SHALLOW FOCUS EARTHQUAKES(U) HAWAII INST OF GEOPHYSICS HONOLULU D A WALKER SEP 83 AFOSR-TR-84-0059 2/2

UNCLASSIFIED F49620-81-C-0065 F/G 8/11 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Acknowledgements. This research was supported by the Office of Naval Research (code 425GG). Funds for support of the hydrophone station at Wake Island were provided primarily by the Air Force Office of Scientific Research under Contract No. F-49620-81-C-0065, with supplementary support from the U.S. Arms Control and Disarmament Agency. The authors express thanks to Dave Byrne, Grant Blackinton, Bob Mitiguy, Dave Barrett, and Fred Duennebier for their help in modifying, testing, launching, and recovering the OBH's. Appreciation is also expressed to Al David and Kentron Corporation for their part in maintaining the recording station at Wake. The authors also thank George Sutton for reviewing this manuscript, and Rita Pujalet for editorial assistance. Hawaii Institute of Geophysics Contribution No. 0000.

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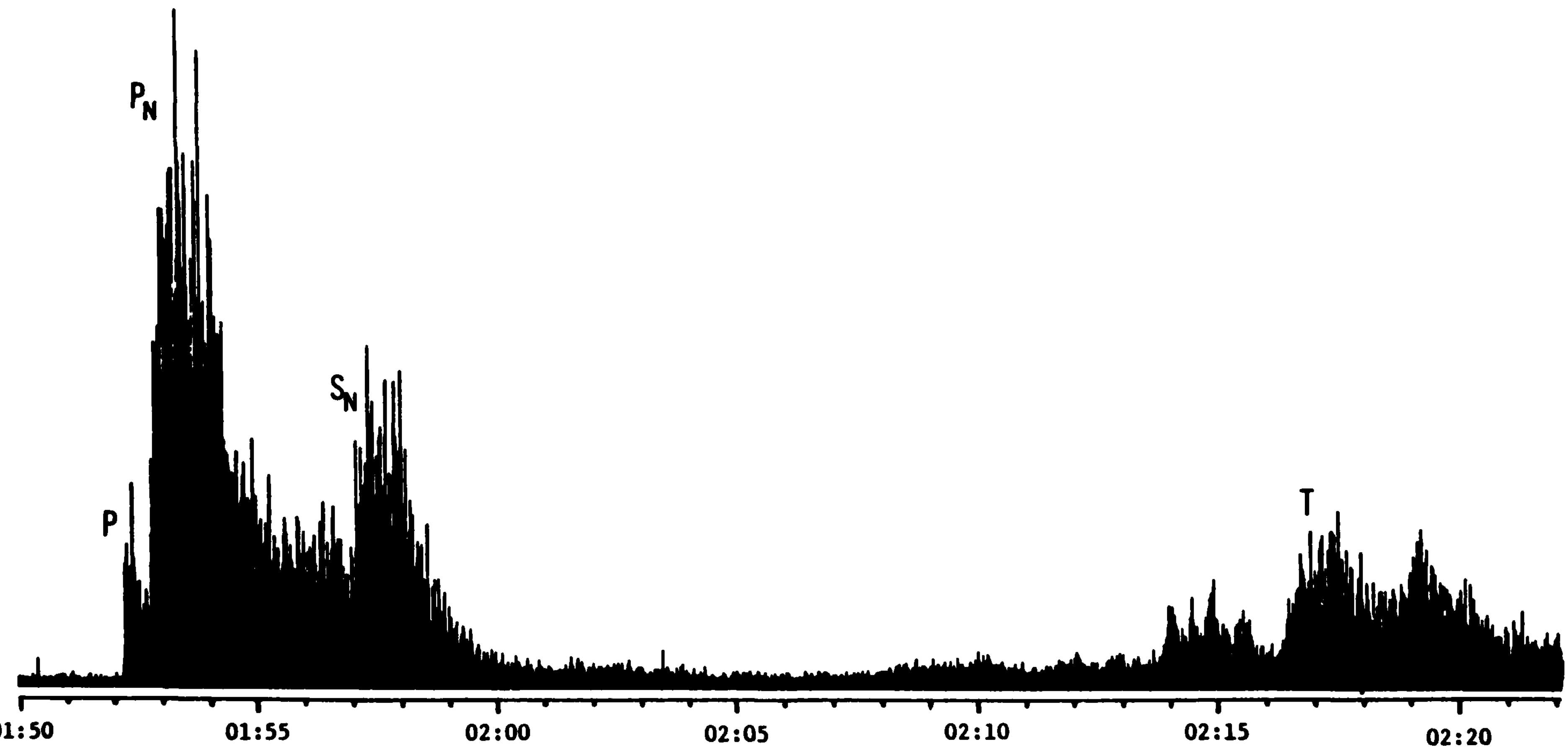
APPENDIX VI

OPA

Newsletter of the Ocean P Alliance
Number 1 September 15, 1982

6 SEPTEMBER 1982; 01:47:02; 29.3N,140.3E; 6.6 M_B; 167 KM; SOUTH OF HONSHU; DISTANCE = 25.2°



OPA

NEWSLETTER OF THE OCEAN P ALLIANCE

The purpose of OPA, the newsletter of the "Ocean P Alliance," is to stimulate interest in a seismic phase known as "Ocean P." This phase, Po, and its associated S phase, So, were first observed in the North Atlantic and have since been found throughout the North, Western, and Central Pacific. First arriving Po/So phases travel with fairly constant apparent velocities of about 8.0 and 4.6 km/sec, respectively, while peak arrivals have velocities (about 7.6 and 4.5 km/sec) comparable to basal crustal rates. At distances of about 18° (~ 2000 km), observed frequencies of Po and So are as high as 30 and 35 Hz, respectively; and at distances of about 30°, as high as 15 and 20 Hz, respectively. The signal-to-noise ratios for Po/So phases are generally at least ten times greater than the ratios of their respective normal, mantle-refracted P and S phases; and, in many instances no P's and S's can be found in spite of the presence of very strong Po's and So's.

Aside from the SOFAR channel of the world's oceans, the Po/So waveguide appears to be the earth's most efficient acoustical waveguide (estimates of Q are as high as 20,000). Also it seems probable that the phenomenon is a dominant feature of all of the world's oceans and marginal seas.

In spite of these remarkable and extensive observations, Po/So research has not yet received the general recognition, interest, and support that it deserves. Recent observations indicate the phenomenon is not just of interest in terms of basic science, but applied science as well. The applied aspects include the detection and discrimination of underground nuclear explosions along subduction zones and/or continental margins, large-scale mapping of the crust and uppermost mantle of the world's oceans and marginal seas, and acoustical studies of ocean sediments and crust at high frequencies.

In view of the foregoing discussions, the intent of this newsletter is to promote interest in Po/So research by providing an additional, and more effective, forum for the exchange of observations and ideas. Contributions or correspondence should be addressed to:

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Rm. 432, HIG, U. of H.
2525 Correa Rd.
Honolulu, HI 96822

Views expressed in this publication are those of the authors only and do not reflect official positions of the Ocean P Alliance unless expressly stated.

Acknowledgments. The concept of a newsletter to improve communications among those interested in Po/So research grew directly out of responses to my 30 March letter. I thank all of those who pr—vided this encouragement. I would also like to express my appreciation to a few visionary program managers at the National Science Foundation, the Office of Naval Research, the Air Force Office of Scientific Research, and the U.S. Arms Control and Disarmament Agency .

Dear Potential Ocean P Alliance Members:

On 30 March 1982, I wrote a rather lengthy letter to some of you concerning seismic phases variously referred to as high-frequency Pn/Sn, long-range Pn/Sn, or Ph.f./Sh.f. It was, and is, my opinion that the level of interest in, and support for, research on these phases was far less than commensurate with their potential importance to geophysics. [In the event that your may have misplaced the 30 March letter, some of the more significant observations are summarized in the masthead.] To share this concern and to obtain an objective assessment, I requested that you reciprocate and express your views to me.

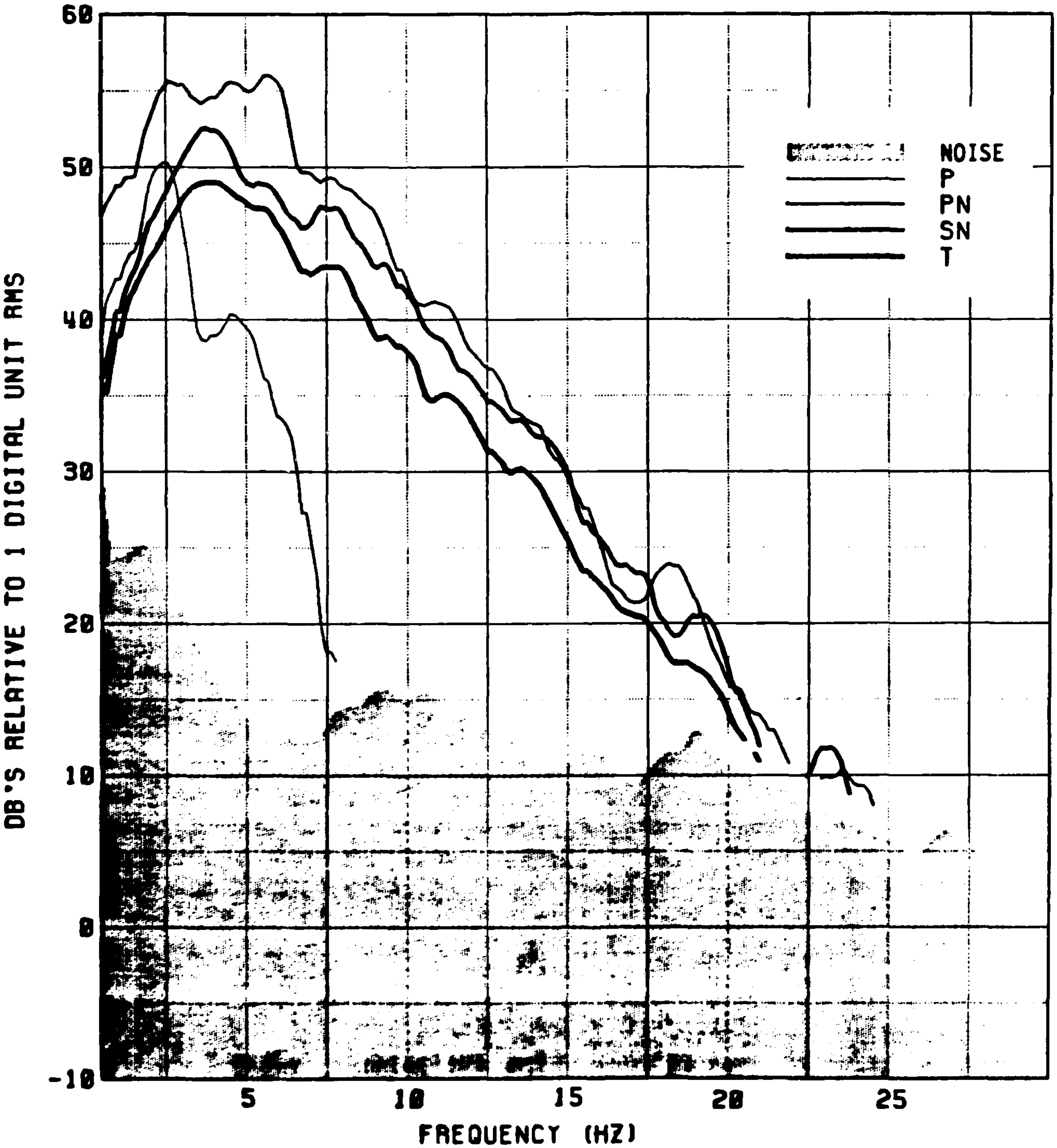
As you may have guessed, the response has been very encouraging—so much so that you have before you a new means for the exchange of observations and ideas on the phenomenon of "high-frequency Pn/Sn" propagation.

Rationale. The history of research on these phases since they were first recognized nearly fifty years ago could best be described as sporadic--with only a small number (often zero) of researchers actively studying the phenomenon at any given time. Such efforts for those early years are understandable. Unfortunately, even with the advent of ocean-bottom hydrophones, digital systems which greatly facilitate spectral analyses, and rapidly evolving computer techniques for modeling complex seismic phases, the number of researchers actively studying the phenomenon is still small. As a result much of what we publish is given little attention, or is totally ignored; and this situation is exacerbated by the large number of journals ("haystacks") in which these studies ("needles") can be published.

Thus, the timing now seems appropritate for building a larger constituency and pushing for a solution. Legitimate means are increased communications, as well as continuing quality research. Without such an effort at this time, I am fearful that research on the phenomenon will still be dangerously close to the "sporadic mode," making hard times and additional periods of dormancy very real possibilities.

I believe the assessment that high-frequency Pn/Sn propagation is "a challenge remaining to the theoretician," (Richards, 1979, Rev. Geophys. Space Phys., 17, 312-328) and is "the challenge to both explosion and earthquake seismology for the coming decade" (Hirn et al., 1973, Z. Geophys., 39, 363-384). I also believe that the opportunities for widespread participation in the solution of major geophysical problems are increasingly rare and that such opportunities should be seized.

Name Change. It may be advantageous at this time to suggest that a new name be given to the high-frequency compressional and shear phases observed at great distances in the world's ·ans. The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difficulty with the nomenclature used to date is that: (1) an, as yet, unsubstantiated relationship to the well known longer-period Pn/Sn phases of continents is inferred; and (2) the environmental feature most strongly linked to the observations is not cited. Thus, a more logical term would be "Ocean P" or "Ocean S" with the abbreviations being "Po/So." With this change, those unfamiliar with the phenomenon would not be as likely to make the false assumption that the phases are similar to continental Pn and Sn. Such assumptions in the past have been a major stumbling block in stimulating interest and support for "Po/So" research.

Our Birthday. You may have noticed something special about the date of this inaugural newsletter--15 September 1982 commemorates the 47th anniversary of the first known published report of Po/So phases.

"In the bulletin of the Harvard Seismograph Station, under date of September 15, 1935, attention was directed to the unusual character of certain records from the vicinity of 17°N, 62°W. One of the novel features was a short-period phase about 23 minutes after P. It has become known as T, for third, with P and S constituting the first and second groups of short-period waves of similar general appearance. The problem was discussed with Weston, and since that time those two stations have been working on it. Linehan published in 1940 the first description outside station bulletins." [Leet et al., 1951, Bull. Seismol. Soc. Am., 41, 123-141].

"At the 1939 meeting of the Eastern Section of the Seismological Society of America, the author presented a paper on earthquakes occurring about 15° to 30° distance from Weston, Massachusetts. The difficulty of locating these quakes was stressed in the paper, due to the strange characteristics of the recordings. Observers of many stations thought of them as a series of locals. As has been mentioned, the records from this area are quite different from those we have recorded from other locations. The predominant characteristic is the multiplicity of their extremely short period. The so-called P-group may last as long as three or four minutes due to the multiplicity mentioned and frequently runs into the S-group: The second group lasts about the same length of time as the former. About 20 minutes after the P-group is a third unidentified group which we have labelled as T." [Linehan, 1940, EOS Trans. AGU, 21, 229-232].

"Actually, many features of P and S are abnormal on this and later records from certain areas at this distance range, and work on that part of the problem is in progress, but the investigation of T has been undertaken first." [Leet et al., op. cit.]

As I stated in my 30 March letter, although the T-phase was accurately identified in a relatively short time as compressional energy traveling in the sound channel of the world's oceans, one could best describe work on the other "part of the problem" (i.e., the "abnormal" P and S phases), 47 years later, as still being "in progress."

It is my hope that on the 50th anniversary of the first reported observations of Po and So, the need for a special newsletter would no longer exist.

Success. The minimum objective of the newsletter is nothing more than the stimulation of deserved interest in Po/So research. Achievements beyond the minimum objective will be strongly dependent on contributions and correspondence from members and their "lobbying efforts" with program managers.

Membership. The "Ocean P Alliance" is not at the moment a formal organization. If no useful purpose would be achieved by "formalization" then this current status should remain unchanged. Anyone wishing to be considered as a member of the Alliance is automatically "in." Anyone wishing to remain skeptical, but nonetheless interested, could consider themselves, if they wish as non-members and still receive the newsletter. I may at some later date directly ask you for your opinions on the newsletter.

I would hope that those receiving the newsletter would provide: (1) The names and addresses of individuals who should be added to our mailing list, and (2) Po/So publications which should be added to our Po/So bibliography, as well as news of forthcoming publications. If you have some other newsworthy items or comments on topics discussed in OPA, please send them to me. I would also like to know if you have been mistakenly placed on the mailing list.

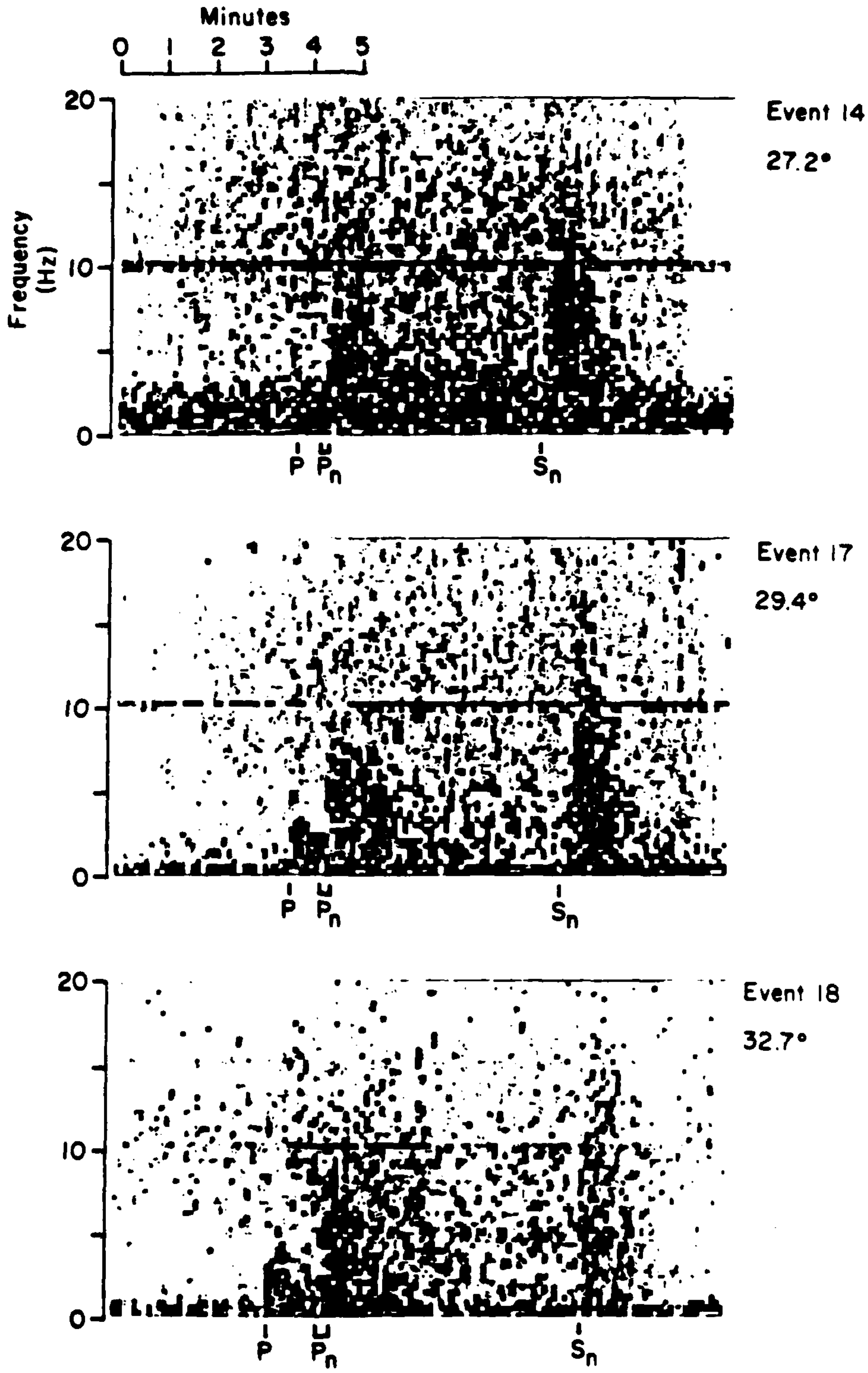
Format. We hope that you will save all issues of OPA for future reference. To that end we have a format conducive to storage in a 3-hole binder.

Future Topics. Items for future issues include the OPA mailing list, correspondence from members, a bibliography of Po/So research, more amazing Po/So recordings, news of upcoming publications, and interesting questions for debate.

Our Covers. To further commemorate the first reported observation of Po, So, and T phases in September of 1935 across the North Atlantic Basin, we have covered our newsletter with Po, So, and T phases which were generated in September of 1982 across the Northwestern Pacific Basin. In addition, the normal, mantle-refracted P is also shown. These phases were recorded on a twelve channel hydrophone array located near Wake Island. Do you see any similarities between these Pacific phases and those from the Atlantic discussed by Leet et al. (op.cit) and Linehan (op. cit.)? What significant observations can be made from these plots? For answers, "tune in" to the next issue of OPA!

Dan Walker

APPENDIX VII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OPA

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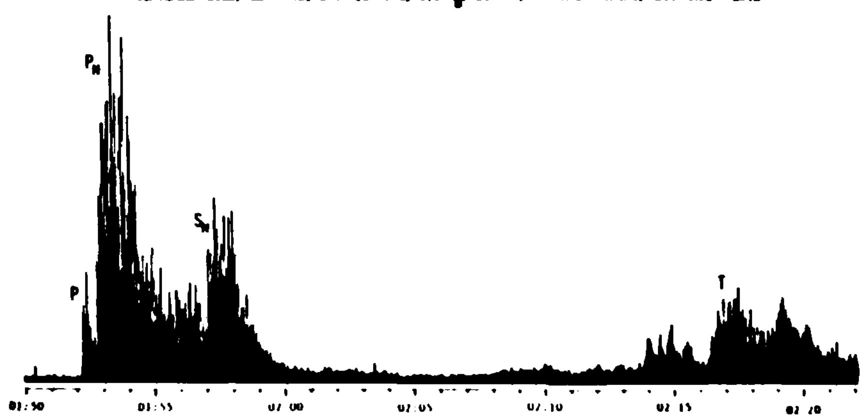
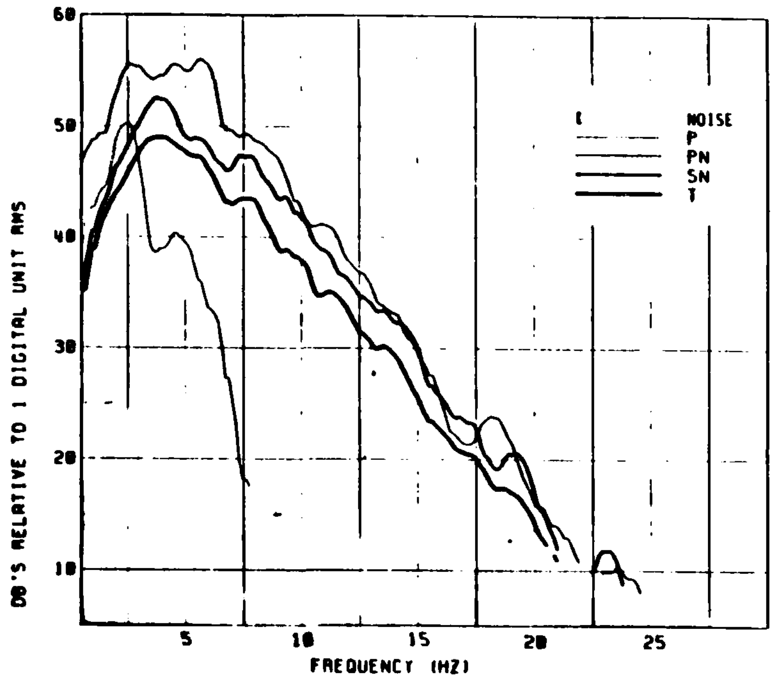
Dear Colleague:

As you may recall, the covers for our inaugural issue consisted of a digitally rectified and compressed plot of P, Po, So, and T phases for an earthquake south of Japan recorded by the Wake hydrophones (front cover) and spectrums for these same phases (back cover). For purposes of the discussion which will follow these figures are repeated here in a severely reduced form. In closing the inaugural issue, I asked whether you could see any similarities between these Pacific phases and those from the Atlantic discussed by Leet, Linehan, and Berger (1951) and Linehan (1940). The unusual characteristics mentioned by these authors are the similar general appearance of their so-called P (primary) and S (secondary) groups to the later arriving T (tertiary) group, the multiplicity of their extremely short period with the P frequently running into the S group, and S about as long as P.

Certainly all of these characteristics have been seen in the Pacific as exemplified in the figures shown here. The P, S, and T groups are of the same general appearance, the P group runs into the S group, in some respects the S group may be about as long as P, and the phases are of extremely short period. The striking and remarkable similarities of these phases are most evident in the spectrums, which also serve to quantify their short period content.

6 September 1982; 01:47:02; 29.3N,140.3E; 6.6 M_b; 167 km; South of Honshu; Distance = 25.2°





The T Phase: A New Approach to Po/So Research. Especially intriguing is the detailed correlation of the T spectrum to the So spectrum. This and the general correlation of the T and Po spectrums suggests a possible new approach to Po/So research. In the future it would seem appropriate to consider the possible relationship of Po and So to T. [Other evidence suggesting a possible relationship of Po and So to T is contained in the report "Oceanic Pn/Sn Phases: A Qualitative Explanation and Reinterpretation of the T-Phase" (D. Walker, HIG Report 82-6, 1982). [Topics from this report are discussed in this newletter].

Spectrums for Atlantic Po, So, and T Phases: A Challenge for East and Gulf Coast Seismologists. I believe that Leet, Linehan, and Berger would be surprised at just how short the periods were for the phases they observed. Unfortunately, the recordings and instrumentation which they had (in all probability 60 mm/minute analog recordings from standard 1 Hz instrumentation) did not permit them to see just how high the frequencies were. In the deep ocean near Wake, forty years later, we have the advantages of lower noise in the 3 Hz to 15 Hz range than most continental stations, a better system response to those frequencies than conventional 1 Hz instrumentation, digital recordings, and computers which facilitate the derivation of spectrums. It is nonetheless surprising that spectrums of Atlantic Po, So, and T phases have not been published. (If I am mistaken, I hope someone will write and provide references.) It would be interesting to compare these spectrums to those from the Pacific. I hope that some east or gulf coast seismologists will take the challenge and be the first to quantify the frequency content of Atlantic Po/So phases.

Continuing Japanese Research on Po/So. I was pleased to meet recently with Drs. Nagumo and Kasahara and to review a preprint of their new paper, with Drs. Ouchi and Koresawa, on OBS observations of Po/So phases. The report contains important information on Po/So velocities. I wish them every success in efforts to publish this important paper.

Po/So Bibliography. One of the major objectives of the OPA Newsletter is to acquire a comprehensive and up-to-date bibliography of Po/So research. A preliminary attempt to achieve this objective follows. I hope that readers aware of omissions will bring them to my attention so that they can be added to the listings.

Our Covers: Now you see "it". Now you don't! The covers are spectrograms from the Wake Island hydrophones. Expected times of arrivals are based on either the Jeffreys-Bullen tables for P or Po/So travel time curves. The contour interval is 8 db. The line at 10 Hz is due to time code cross talk.

What's "it"? The So - very strong on the front cover, but weak or absent on the back cover. Phases shown on the front cover are typical of events from the Japan, Kuril, Kamchatka portion of the circum-Pacific arc; and, therefore, these phases have travel paths to Wake under the deep Northwestern Pacific Basin. Phases shown on the back cover are typical of events from the New Ireland and Solomon Islands area; and, therefore, these phases have travel paths to Wake under the shallow Ontong-Java Plateau as well as portions of the deep Northwestern Pacific Basin.

An obvious explanation is differences in source characteristics. Unfortunately, this seemingly reasonable explanation cannot be correct, since So phases from the New Ireland and Solomon Islands area are well recorded at Ponape on the northern margin of the Ontong-Java Plateau (roughly mid-way between the source locations and the receivers at Wake). [Of the more than forty events from the New Ireland and Solomon Island area recorded at Ponape during an approximate seventeen month experiment, amplitudes of So phases are at least comparable to, and frequently larger than, those of their respective Po phases.]

What, then, could be the explanation? Possible clues are: (1) the transition [illegible] allower Ontong-Java Plateau to the deeper Northwe[illegible]; and (2) the frequent absence or weakness of So, [illegible] presence of Po, at great distances (often more

than 4000 km) throughout the North Pacific (Walker, 1977a and b) and Central Pacific (Talandier and Bouchon, 1979), in spite of stronger So's than Po's for relatively homogeneous travel paths across the deep Northwestern Pacific Basin.

A possible explanation will be given in the next issue of OPA. Please send any comments or suggestions on this or other items.

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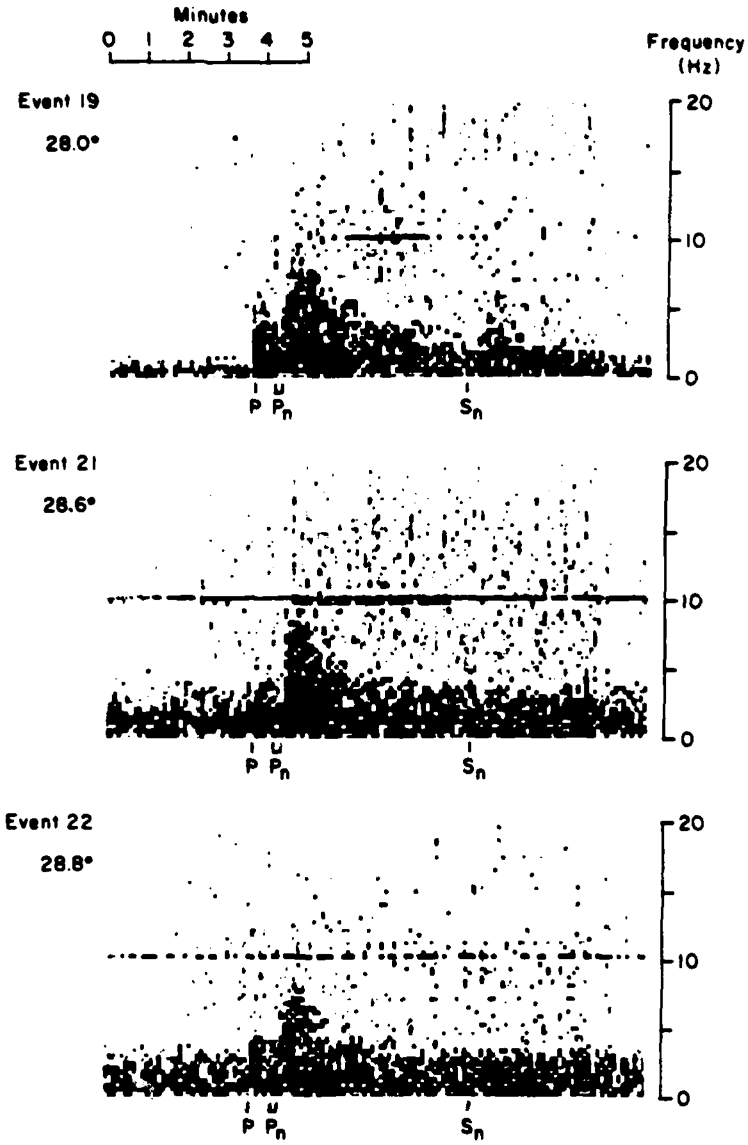
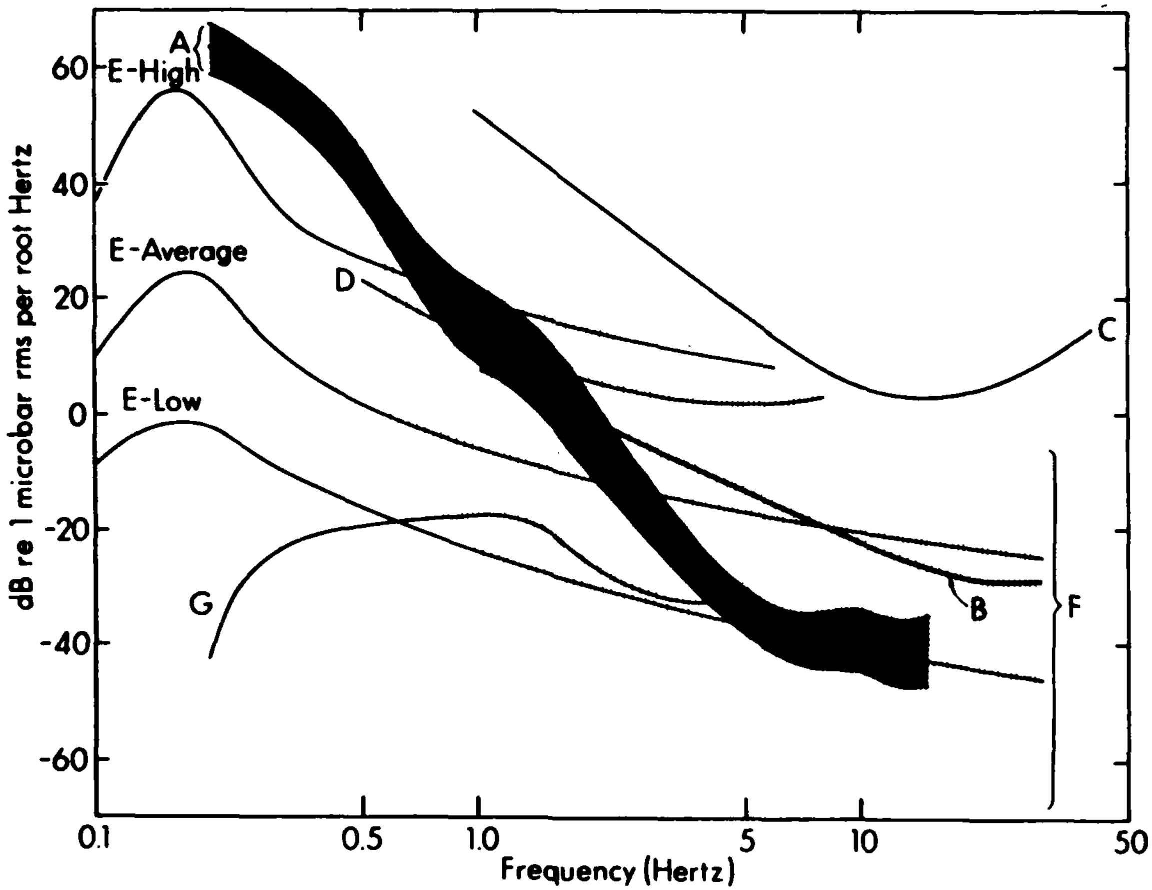


Minutes
0 1 2 3 4 5
Frequency (Hz)
Event 19
28.0°
Event 21
28.6°
Event 22
28.8°
20
10
0
P
P_n
S_n

APPENDIX VIII


A
E-High
E-Average
E-Low
D
C
B
F
G
60
40
20
0
-20
-40
-60
0.1
0.5
1.0
5
10
50
Frequency (Hertz)
dB re 1 microbar rms per root Hertz

OPA

NEWSLETTER OF THE OCEAN P ALLIANCE

The purpose of OPA, the newsletter of the "Ocean P Alliance," is to stimulate interest in a seismic phase known as "Ocean P." This phase, Po, and its associated S phase, So, were first observed in the North Atlantic and have since been found throughout the North, Western, and Central Pacific. First arriving Po/So phases travel with fairly constant apparent velocities of about 8.0 and 4.6 km/sec, respectively, while peak arrivals have velocities (about 7.6 and 4.5 km/sec) comparable to basal crustal rates. At distances of about 18° (~ 2000 km), observed frequencies of Po and So are as high as 30 and 35 Hz, respectively; and at distances of about 30°, as high as 15 and 20 Hz, respectively. The signal-to-noise ratios for Po/So phases are generally at least ten times greater than the ratios of their respective normal, mantle-refracted P and S phases; and, in many instances no P's and S's can be found in spite of the presence of very strong Po's and So's.

Aside from the SOFAR channel of the world's oceans, the Po/So waveguide appears to be the earth's most efficient acoustical waveguide (estimates of Q are as high as 20,000). Also it seems probable that the phenomenon is a dominant feature of all of the world's oceans and marginal seas.

In spite of these remarkable and extensive observations, Po/So research has not yet received the general recognition, interest, and support that it deserves. Recent observations indicate the phenomenon is not just of interest in terms of basic science, but applied science as well. The applied aspects include the detection and discrimination of underground nuclear explosions along subduction zones and/or continental margins, large-scale mapping of the crust and uppermost mantle of the world's oceans and marginal seas, and acoustical studies of ocean sediments and crust at high frequencies.

In view of the foregoing discussions, the intent of this newsletter is to promote interest in Po/So research by providing an additional, and more effective, forum for the exchange of observations and ideas. Contributions or correspondence should be addressed to:

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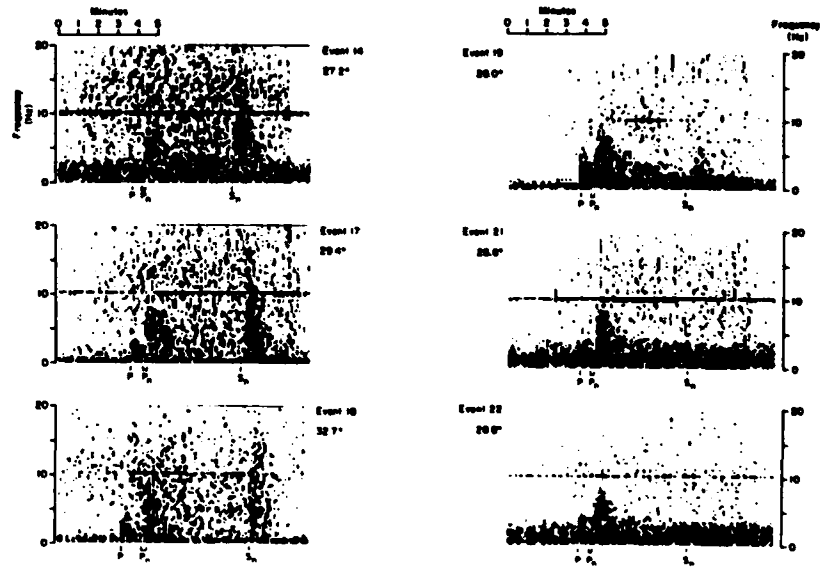
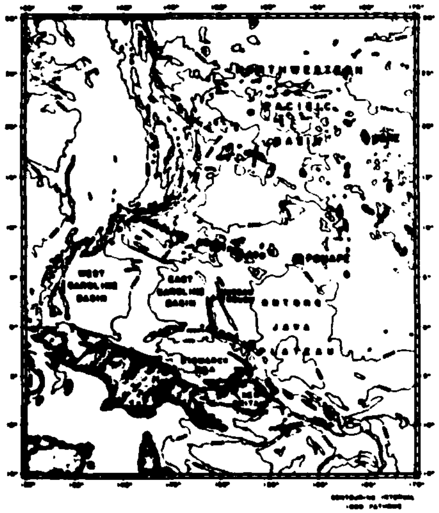
Views expressed in this publication are those of the authors only and do not reflect official positions of the Ocean P Alliance unless expressly stated.

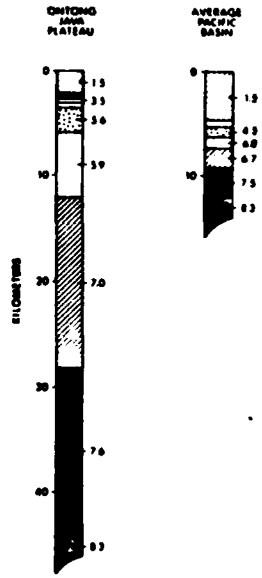
Dear Colleague:

The covers of our last issue, shown here in reduced form, are spectrograms for phases with travel paths to the Wake Island hydrophones under the deep Northwestern Pacific Basin (front cover) and under the shallow Ontong Java Plateau (back cover). An obvious explanation for the absence, or weakness, of So (labeled Sn) on the back cover is differences in source characteristics. However, recordings made during an earlier experiment at Ponape, roughly midway between the receivers at Wake and the source locations of earthquakes in the New Ireland and Solomon Island area (see accompanying map), indicate that this explanation can not be correct. Over an approximate seventeen month recording period, more than forty events from the New Ireland and Solomon Island area were recorded, with the amplitudes of So at least comparable to, and frequently larger than, those of their respective Po phases.

An observation which contributes to a possible explanation is the frequent absence or weakness of So, yet presence of Po, at great distances (often more than 4000 km) throughout the North Pacific (Walker, 1977a and b) and Central Pacific (Talandier and Bouchon, 1979), in spite of stronger So's than Po's for relatively homogeneous travel paths across the deep Northwestern Pacific Basin.







The explanation arising from these observations, then, is that paths other than those across relatively homogeneous ocean basins are likely to encounter large lateral changes in the crust and upper mantle. Observations require that the changes be such that So signal strength is reduced without seriously affecting the Po phase. Large lateral changes could be produced by plateaus, rises, ridge systems, island and seamount chains, fracture zones, transform faults, fossil arcs and trenches, and rafted continental fragments. The transition from the shallow Ontong Java Plateau to the deeper Northwestern Pacific Basin (see accompanying figures), as well as the extension of the Caroline Archipelago through this region, could be features responsible for the weak, or absent, So's at Wake from events in the New Ireland and Solomon Island area. [This interpretation has been taken from a recent attempt (Walker, 1982) to provide a qualitative framework consistent with all of the diverse observational aspects of Po/So - hoping that this would eventually lead to comprehensive and detailed quantitative analyses and, ultimately, a generally acceptable model for the generation and propagation of Po/So.]

Nuclear Connections. In the masthead of this newsletter, reference is made to Po/So being of interest in terms of the detection and discrimination of underground nuclear explosions. It may be worthwhile at this time to be more explicit as to possible reasons for such interest.

A. Obvious - Large S/N Ratios for Po/So. An examination of the covers of previous OPA newsletters is all that is needed to suggest that S/N ratios for Po/So may be larger than the ratios for mantle refracted P (S is not generally apparent for distances of up to about 20°). Indeed, numerous observations from the deep ocean, as well as hard rock island sites, in the Western Pacific indicate the S/N ratios for Po/So at their dominant frequencies (about 4 to 8 Hz) are generally from 5 to 10X greater than the S/N ratios for P at its dominant frequencies (about 1.5 to 2.5 Hz). This dominance may extend out to distances of 3000 km, with P increasing in strength relative to Po/So beyond this range. Also, at distances less than about 20°, the travel times of Po phases are such that they may arrive ahead of the mantle refracted P, thus masking whatever P energy may be present.

Although some of the most extensive observations of Po/So phases have been in the Western Pacific, these phases have also been observed in other portions of the Pacific and the North Atlantic. The nature and extent of those observations suggest that the phenomenon could be a dominant feature of all the world's oceans and marginal seas.

Thus regional detection and discrimination of underground explosions with seismic instrumentation in an ocean environment (islands, the water column, bottom, or sub-bottom) may in large part be based on Po/So recordings.

As to why detection and discrimination in an ocean environment should be important, one has only to look at a globe. As to whether, in fact, detection and discrimination in an ocean environment is important, one has only to consider recent investments in ocean sub-bottom seismometers.

B. Less Obvious - Lg/Pg Comparisons. Just as Po/So are the most prominent phases recorded at regional distances for oceanic travel paths, Lg and Pg are prominent phases recorded at regional distances for continental travel paths. Certainly Lg/Pg are of great importance in regional detection using continental stations (just as Po/So should be of great importance in regional detection using oceanic stations). Surprisingly, the much studied phenomenon of Lg/Pg suffers problems of understanding not unlike those associated with Po/So. In a recent publication (1983) Gupta and Blandford state:

"The mechanism for the generation of transverse component motion from explosions is still not clearly understood in spite of the large number of studies on the subject." [p. 571] and "... no convincing explanation has so far been offered for the generation of short-period (about 1 sec or less) transverse motion from explosions." [p. 572.]

[In their report they propose a scattering mechanism for the generation of short period transverse motion (including Lg) from explosions.]

Regarding the utility of Lg/Pg in the discrimination of nuclear explosions, several theoretical studies suggest a strong dependence of Lg/Pg signal character on focal depth. Also, Gupta and Blandford note that "the observed differences in the spectra of shear waves

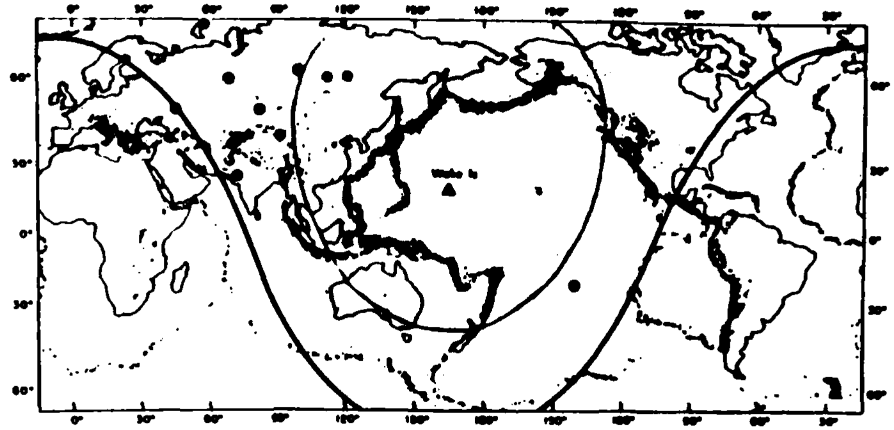
(i.e., Lg) from explosions and earthquakes seem to be large enough to be useful for source discrimination". [p. 589].

Could it be that Lg/Pg investigators might better understand certain aspects of Lg/Pg by turning their attention to Po/So? Or, conversely, might Po/So investigators better understand Po/So by turning their attention to Lg/Pg? Because of the thinness and uniformity of the oceanic crust and upper mantle under the deep ocean basins relative to that under large portions of continents, could Po/So be viewed as less adulterated (and, therefore, less complex) forms of Lg/Pg? And, finally, could comparative studies of Lg/Pg and Po/So lead to important breakthroughs in detection and discrimination capabilties on continents and in the oceans?

In my opinion all of these questions are very important. If you share this view, I hope that you will bring the phenomenon of Po/So to the attention of your associates who may be working on Lg/Pg. I am happy to report that at least one organization (Rondout Associates Incorporated) has recognized the potential of comparative studies between Po/So and Lg/Pg in the form of a research proposal submitted to AFOSR. [Indeed, most of my views on this topic were based on discussions presented in that proposal.]

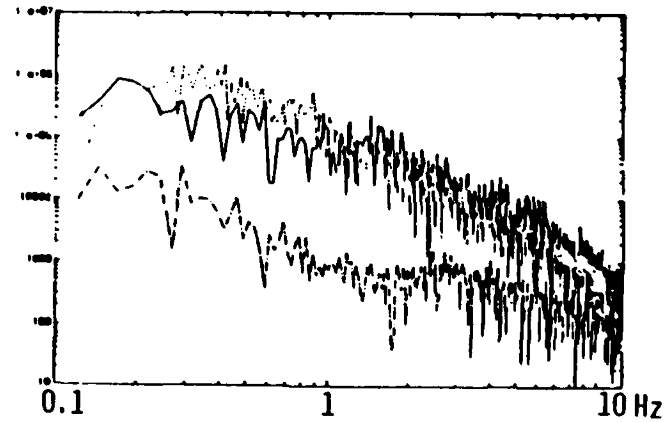
C. <u>Indirect - Mantle Refracted Explosion P's.</u> Our front cover is a plot of estimated ocean bottom background noise (shaded region "A") near Wake Island compared to other measurements. [A detailed description of this figure is given at the end of the newsletter.] It is apparent from this plot that the noise levels near Wake for frequencies from about 3 to 15 Hz are comparable to, or better than, levels for some of the best continental sites. This would be of little significance if there were no signals at these frequencies. However, by some fortuitous accident of nature (my apologies to those of you who may be new to the field). Po/So phases (as has already been mentioned) have strong signals in the 4 to 8 Hz range. Further compounding this accident, (a) mantle-refracted P phases from underground nuclear explosions recorded at great distances (i.e., at distances from about 60° to 90°) have suprisingly large amounts of energy at frequencies above 3 Hz, with higher corner frequencies than earthquakes at comparable distances;(b) explosions with smaller yields are believed to be relatively richer at higher frequencies;(c) the Wake hydrophones are ideally located in the 60° to 90° distance range from most of the known nuclear test sites (see accompanying figure: the shaded area represents the 60° to 90° distance range; solid circles represent underground nuclear test sites; the 90° boundary is firm since no P energy is observed beyond this distance; the 60° boundary is not firm since high frequency P energy has been observed at shorter distances); and, (d) ocean suface reflections can be used in signal enhancement (see back cover; a thorough description of this figure is given at the end of the newsletter).

The connection, then, is that sites ideal for the study of Po/So may also be of great value in recording underground explosions at great distances. [More detailed discussions of hydrophone recorded explosion P's may be found in a recent publication by McCreery et al. (1983).]

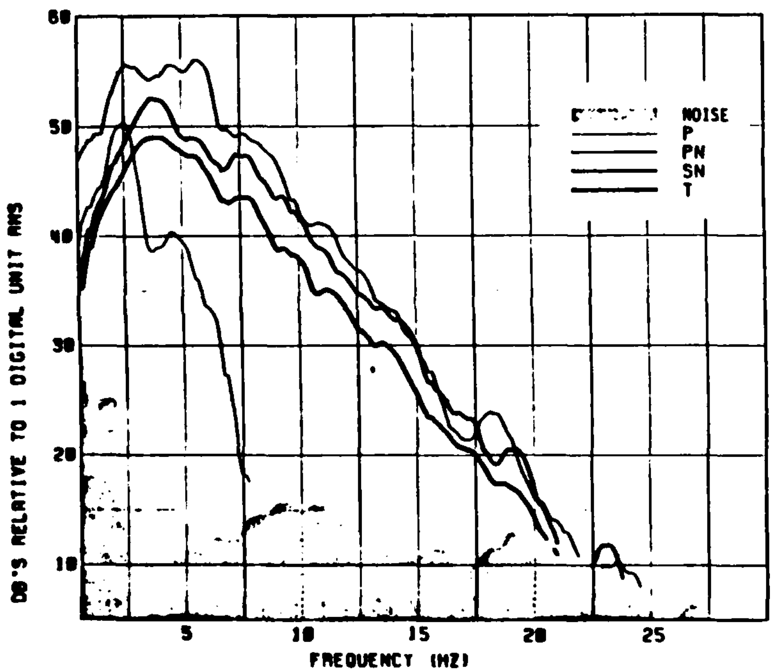


<u>Challenge Answered.</u> Although Po/So phases were first observed nearly fifty years ago on the east coast from an earthquake in the West Indies, I noted in the last newsletter that I had never seen spectrums for Po/So phases from an Atlantic event. Therefore, in the last newsletter, east and gulf coast seismologists were "challenged" to spectrally analyze Po/So phases for Atlantic travel paths.

Suprisingly, that challenge has already been met by Rondout Associates Incorporated (RAI), and they have generously permitted the publication of their spectrums in this newsletter (see accompanying figure). The event occurred near Puerto Rico (h = 189km; mb = 5.7) and was recorded on RAI's Catskill (New York) Seismic Array (CSA) at a distance of 27.8°. Shown are the ground velocity spectra for Po (solid line), So (dotted line), and background noise (dot-dash line).



Comparisons of these spectrums, those on the back cover of OPA No.1 (shown here in reduced form), and the front cover of this newsletter are most interesting. For both sets of spectrums, Po's and So's are well above background noise out to about 10 Hz. The greater S/N ratios recorded on the ocean bottom (Wake hydrophone) at frequencies above 10 Hz may be the result of stronger signals, the lower noise levels of the ocean bottom at those frequencies, and/or greater attenuation of high frequencies by the continental portion of the Puerto Rico to CSA path. The greater S/N ratios recorded on the continent (CSA) at frequencies below 1 Hz is almost certainly a result of the lower noise levels of continents at those values. Therefore, the S/N ratios indicated in the spectrums do appear to be consistent with the noise curves for continents and oceans shown on the front cover of this newsletter.



It is hoped that the publication of the Atlantic Po/So spectrums is just the beginning of many comparative studies with Pacific Po/So phases (e.g.; velocities, spectra, Q's, effects of continental paths, structural interpretations, etc.).

__Po/So Bibliography.__ Some additions to the bibliography published in the last issue of OPA can already be made. Item #1 is a tentative addition since this modeling effort is appliclable only down to periods of 5 seconds and no direct references are made to the "Pn/Sn" phases observed at much higher frequencies for oceanic travel paths (i.e. Po/So). Item #3 was mistakenly omitted from the original list.

1. Menke, W., and P. Richards, 1983, The horizontal propagation of P waves through scattering media: analog model studies relevant to long-range Pn propagation, Bull. Seismol. Soc. Amer., 73, 125-142.

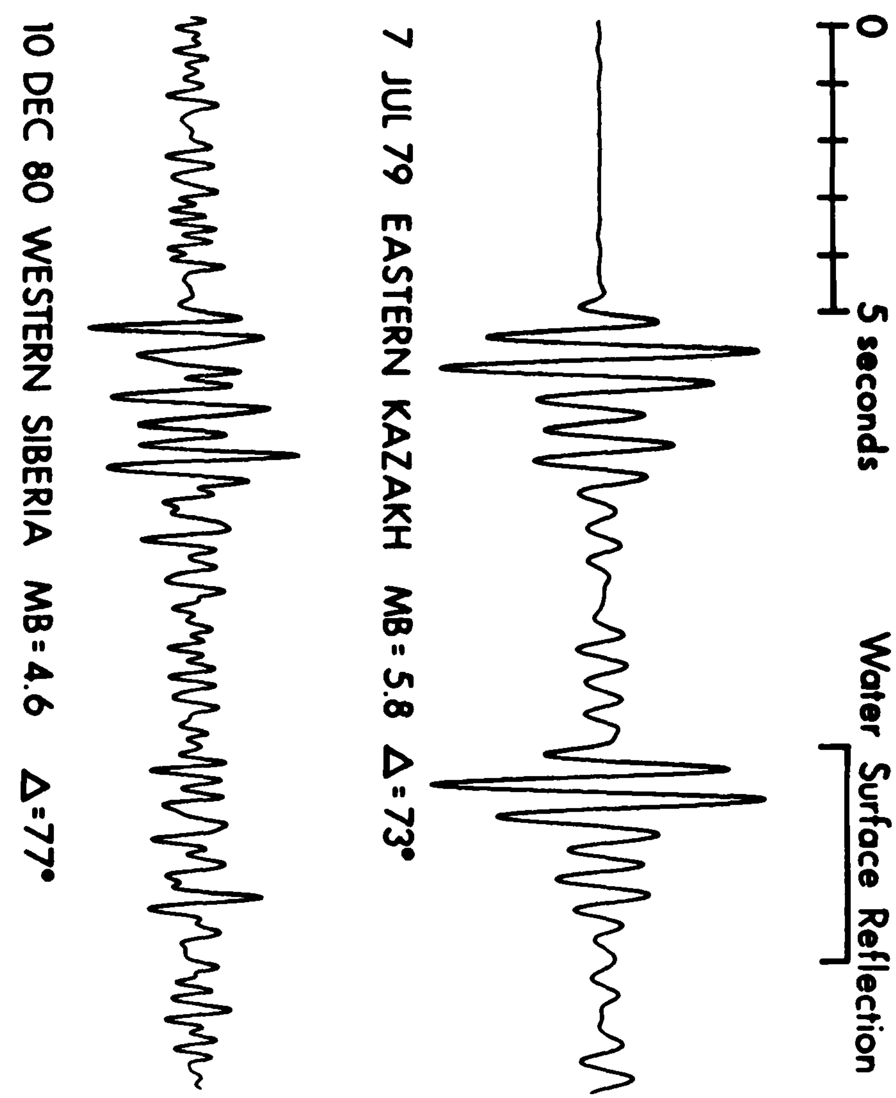
2. Walker, D., C. McCeery, and G. Sutton, 1983, Spectral characteristics of high-frequency Pn, Sn phases in the Western Pacific, J. Geophys. Res., 88, 4289-4298.

3. Walker, D., C. McCreery, G. Sutton, and F. Duennebier, 1978, Spectral analyses of high-frequency Pn and Sn phases observed at great distances in the Western Pacific, Science, 199, 1333-1335.

__Our Covers.__ The front cover shows the average spectrum ± 1 standard deviation of 52 samples of background noise over 18 months from the Wake bottom hydrophones (A). Also shown are some published noise curves for both ocean-bottom (B, C, D, and H) and continental (E, F, and G) environments, which have been converted from an assortment of units to the scale shown. B is a hypothetical "sample spectrum of deep-sea noise" (Urick, 1975; p. 188). C is a vertical seismometer measurement made in the Mariana Basin (Asada and Shimamura, 1976). D is a vertical seismometer measurement made at 4.6-km depth between Hawaii and California (Bradner and Dodds, 1964). H is a noise curve for a hydrophone bottomed off Eleuthera Island at 1200-m depth (Nichols, 1981). E represents low, average, and high noise levels estimated from curves compiled by Brune and Oliver (1959). F is an area bounded by the limits of noise curves measured on vertical seismometers for 16 locations within the United States and Germany (Frantti et al., 1962). G is the noise curve for the Oyer subarray of the Norwegian seismic array measured during a period "when most of the North Atlantic Ocean was very quite" (Bungum et al., 1971). The back cover shows a sample time series of P, filtered to maximize signal/noise, from two nuclear explosions recorded on the Wake bottom hydrophones. The upper trace is from a single hydrophone and shows the direct arrival and its first water surface reflection. The lower trace is a composite of signals from two hydrophones with 40-km separation, obtained as follows: the filtered (1.5-5.0 Hz) time series from each hydrophone was inverted, shifted in time by the water surface reflection time, weighted to maximize the increase in signal/noise, and added to itself; the two resulting time series were then added with the appropriate propagation delay, and weighted to maximize the increase in signal/noise. Signal/noise was increased by 90% of the theoretical maximum with this method, indicating a high level of coherence between the signals added.

Both covers are discussed elsewhere in the newsletter. An interesting question posed by the front cover is this:

"Would instruments with responses comparable to those of the short period components of the World-Wide Seismograph Network (WWSSN) be appropriate for the studies of regional and teleseismic body phases recorded on, or in, the ocean bottom?"



Reminder: You are invited to comment on topics presented in the newsletter and to provide other items of interest. Also, since it is difficult to be aware of all papers published in the many differing geophysical journals, advice on any omissions in the Po/So bibliography would be appreciated. Again, special thanks to RAI for sharing their Po/So spectrums with us.

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APPENDIX IX

The Continuous Digital Data Collection System for the Wake Island Hydrophones

by

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at

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ABSTRACT

A continuous digital data collection system was installed on Wake Island in August, 1982, to record seismic signals from an array of nearby hydrophones. Most of the hardware has been purchased "off-the-shelf" from various nationally known vendors. A few components have been built at the Hawaii Institute of Geophysics (HIG). Software for both the data collection and data reduction has been written at HIG. Some key features of the data collection system are: 1) 96 dB dynamic range (i.e., 16 bits), 2) up to 16 data channels, 3) accurate absolute timing ($\pm$ 1 msec, generally), 4) accurate interchannel timing, 5) power-failure recoverability, 6) up to 80 samples per second per channel (variable), 7) ease of operation (only four operator commands necessary), 8) operator intervention only once per day (to change up to 4 full reels of 9 track tape), and 9) common tape format (blocked data, 2 bytes per word, 2's complement notation). The preliminary data reduction consists of: 1) stripping off intervals of data for which seismic phases from known events are suspected of being present; and 2) stripping off randomly spaced 3-minute intervals (1 per hour on the average) as ambient noise samples. These tasks are accomplished by a series of programs run at HIG on a Harris H800 computer. This paper is primarily intended for the reader who wants to build a digital data acquisition system, or who wants to use the data collected by this particular system at Wake.

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INTRODUCTION

In June, 1979, HIG began operation of a four-channel (3 data, 1 time-code), slow-speed, cassette recording system for continuous monitoring of hydrophones located near Wake Island. The seismic data collected from this system have provided much needed information about ambient noise in the deep ocean, Po/So propagation, and the spectra at high frequencies (i.e., > 2 Hz) of deep mantle P phases from earthquakes and explosions recorded at great distances. However, the recording system itself had limitations which prevented more quantitative types of data analysis. These limitations included: 1) a dynamic recording range of only about 40 dB - this caused many signals to be clipped; 2) poor timing due to clock drift - absolute timing was accurate to only ±0.3 sec.; 3) poor interchannel timing - differences in skew between the recording and playback heads could easily result in a 0.1 sec. timing error between channels; 4) analog format - a sophisticated, time consuming and data degenerating process was necessary to convert the analog signals to digital time series for further processing; and 5) only three of at least eleven working hydrophones could be recorded.

To eliminate these problems, a system was sought with the following general capabilities and constraints: 1) a large dynamic range to record, without distortion, events ranging from at least mb = 4.0 to mb = 8.0 (i.e., at least 80 dB); 2) Absolute timing accurate to less than 0.1 sec (for ease in processing, no time correction should need to be applied to acheive this accuracy); 3) Interchannel timing accurate to within only a small change in phase of the highest frequency of interest (e.g., 0.002 sec for a $\pi/8$ phase change at 30 Hz); 4) a digital recording format such that only a minimal amount of processing is necessary to convert the data to a widely

useable format; 5) the capability to record all eleven available hydrophones; 6) the recording of frequencies at least as high as those already observed at Wake in Po and So (i.e., 30 Hz); 7) operation of the system so simple that it can be accomplished by personnel untrained in computer hardware and software; 8) required servicing (i.e., changing tapes) no more than once per day; and 9) the capability of restarting automatically after power failures (which occur frequently at Wake). After exploring numerous options, a design was chosen which met the specifications outlined above, and also appeared to have the best chance for success in terms of the reliability and intercompatability of its components and the feasibility of writing the necessary data acquisition software. This system was purchased, assembled, softwared and tested between March and August, 1982, and was installed at Wake during the last week of August, 1982.

Because of the large volume of raw data which would be collected by this system (i.e., up to 1460 full reel, 9-track, computer tapes per year) a scheme was desired for compressing the data. Data types which were considered the highest priority for saving are: 1) seismic phases applicable to ongoing research topics, 2) ambient noise samples, and 3) seismic phases for future research topics. A system of programs was written to extract and save those intervals in the raw data which contain these priority events. These programs also manage the data for easy accessibility and transmission to other scientists.

RECORDING SYSTEM HARDWARE

The hardware used for the digital recording system is outlined in the flow chart of Fig. 1. The hydrophone signals are first amplified and shaped by the preamps and pre-whitening filters. Two of these signals are filtered further and used to create a helicorder-style seismogram. All of the signals from the preamps are converted to discrete time series by the A/D (analog to digital) convertor. The digitized data is then assembled into blocks and output to the tape drives by the LSI-11/2 computer. The satellite clock provides a time code for the helicorder, a synchronization signal for the A/D sampling pulse generator, and the date and time in digital format for inclusion with the data blocks written to tape. A more detailed description of the function of each component in Fig. 1 is given below:

Wake Hydrophones

The hydrophones are passive, moving-coil type, which are connected via cable to Wake Island. The estimated response is shown in Fig. 2. The hydrophones are located in two arrays. One array contains six sensors on the ocean floor at 5.5 km depth, and has an aperture of 40 km. The other array consists of five hydrophone pairs at SOFAR depth (1 km) and has an aperture of 300 km. Of the ten hydrophones in the SOFAR array, at least five of them at three sites appear to be working.

Preamp/Pre-Whitening Filters (HIG built)

The preamps are designed to have very low intrinsic noise levels because the hydrophone outputs are very small [as small as 10 nVolts/(Hz)$^{1/2}$ at 10 Hz]. The pre-whitening filters are designed to flatten the ambient

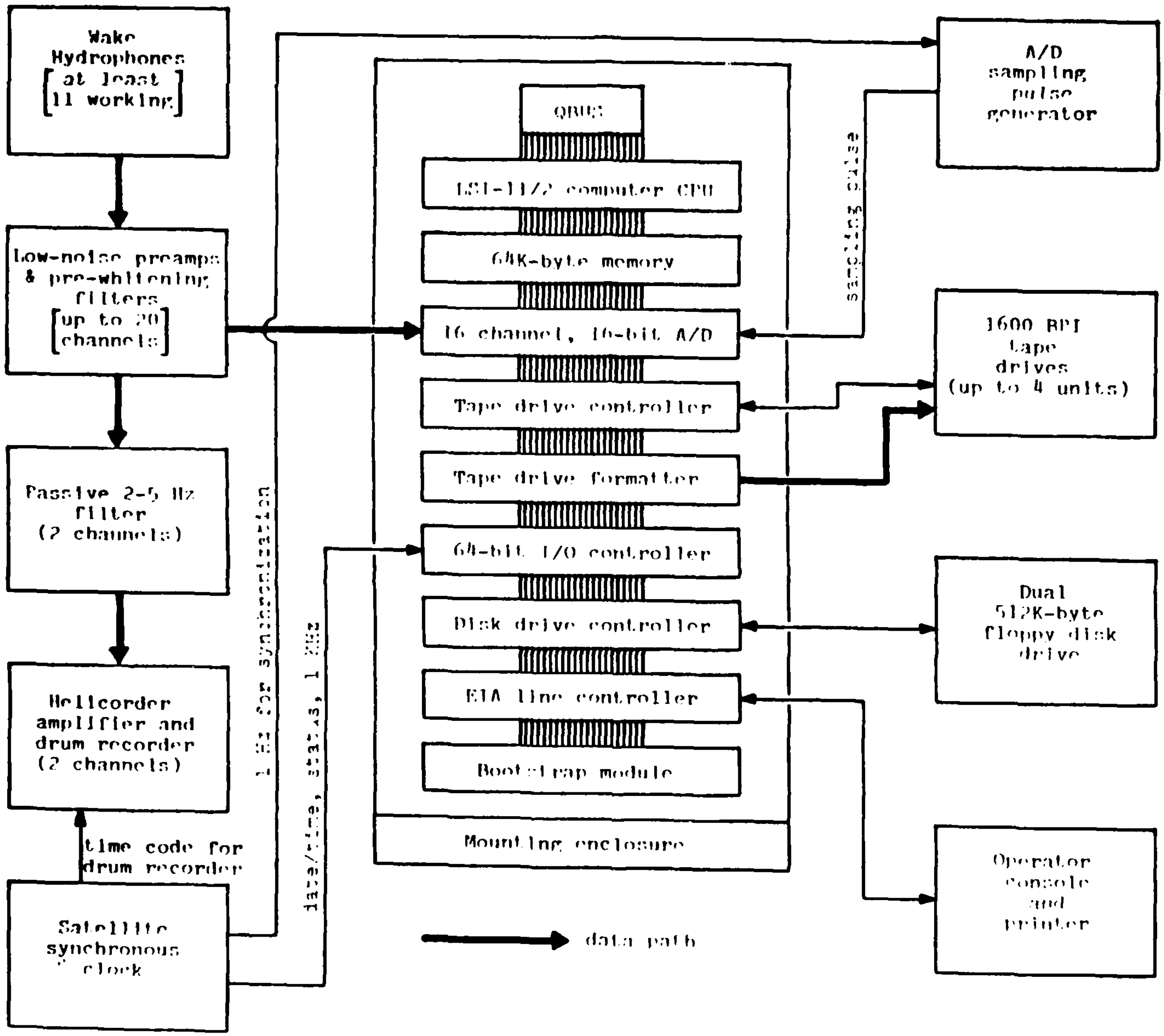


Figure 1. A general diagram of the hardware used for the Wake data acquisition system. Each device on QBUS represents a single printed circuit board, and these boards are mounted in the enclosure from top to bottom as shown.

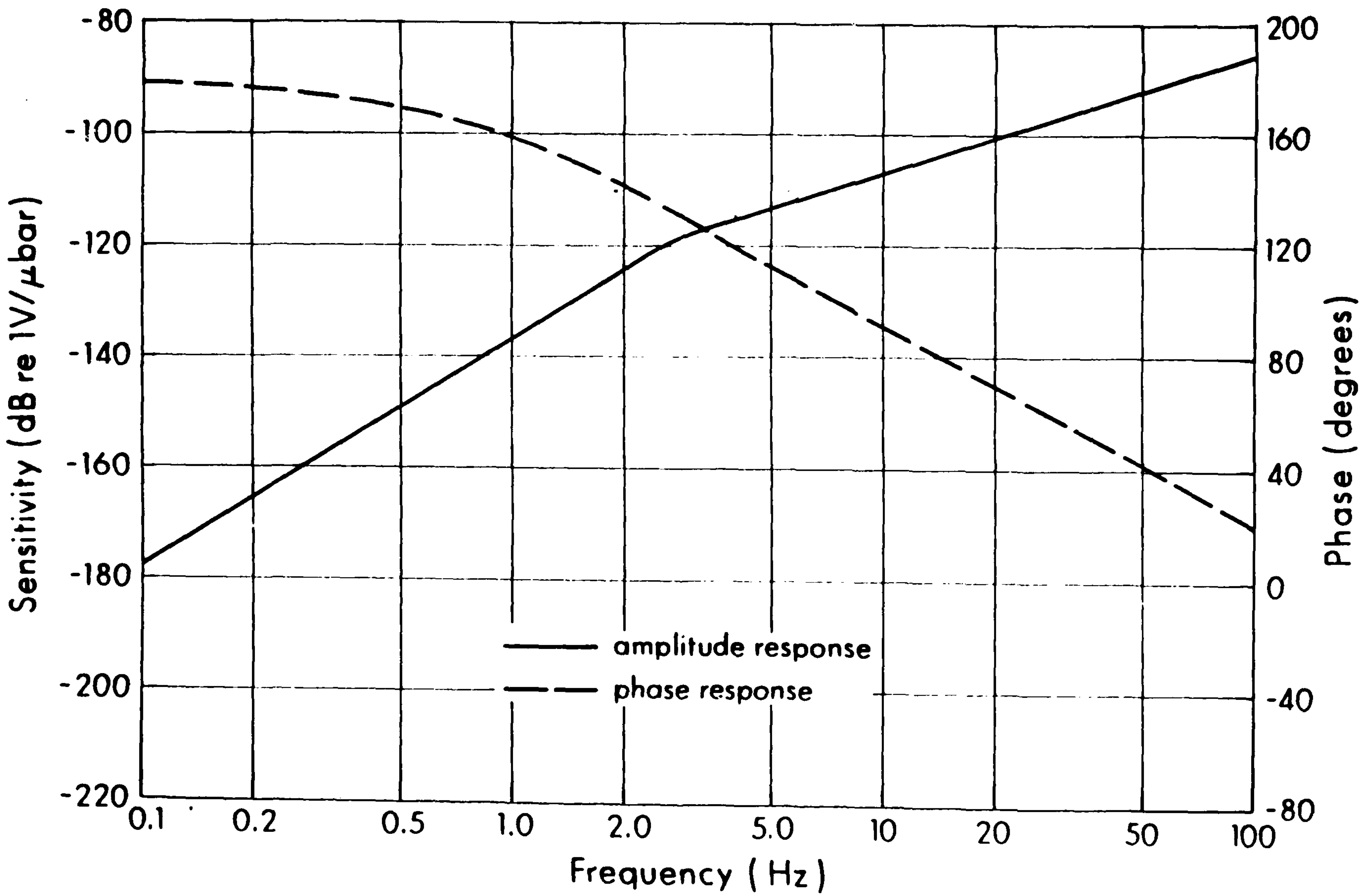


Figure 2. The estimated response of the Wake hydrophones (taken from the Columbia University's <u>OBS Calibration Manual</u> by S. N. Thanos, 1966).

ocean-bottom noise spectrum out of the hydrophone (measured previously using analog data), for the purpose of maximizing the dynamic recording range at all frequencies. Anti-aliasing filters and a 60 Hz notch filter are also included. The output amplifier stage has 10 gain steps (0-9), each 3 dB apart, which can be manually set. The response of the preamp/pre-whitening filters is shown in Fig. 3 (for gain step 9).

A/D Convertor (Data Translation Model DT2784SE/DT5716-B

The A/D convertor is designed to fit into the backplane of the LSI-11/2 computer (i.e., into. QBUS), with a cable and connector for receiving the signals to be digitized. The resolution is 16 bits, giving decimal values between -32,768 and +32,767 for inputs between -10.0 and +10.0 Volts, respectively. Up to 16 single ended inputs are acceptable, and the maximum throughput rate is 2.5 kHz (i.e., a minimum of 0.4 msec between samples). Simultaneous sample and hold of all channels is not available on this board, so the 16 channels are sampled sequentially. Furthermore, the design of this device actually requires that all 16 channels be sampled sequentially; the data of unwanted channels being discarded by the software. The trigger which causes a sample to be taken is provided externally by the A/D sampling pulse generator. An example of the temporal spacing between data points which is created by this scheme is shown in Fig. 4. Digital output from the A/D convertor is loaded directly into the LSI-11/2 core memory via direct memory access (DMA).

Satellite Clock (Kinemetrics model 468 DC)

The satellite clock provides inexpensive accurate time at a remote site by monitoring signals from the GOES satellites (East or West). Accuracy is

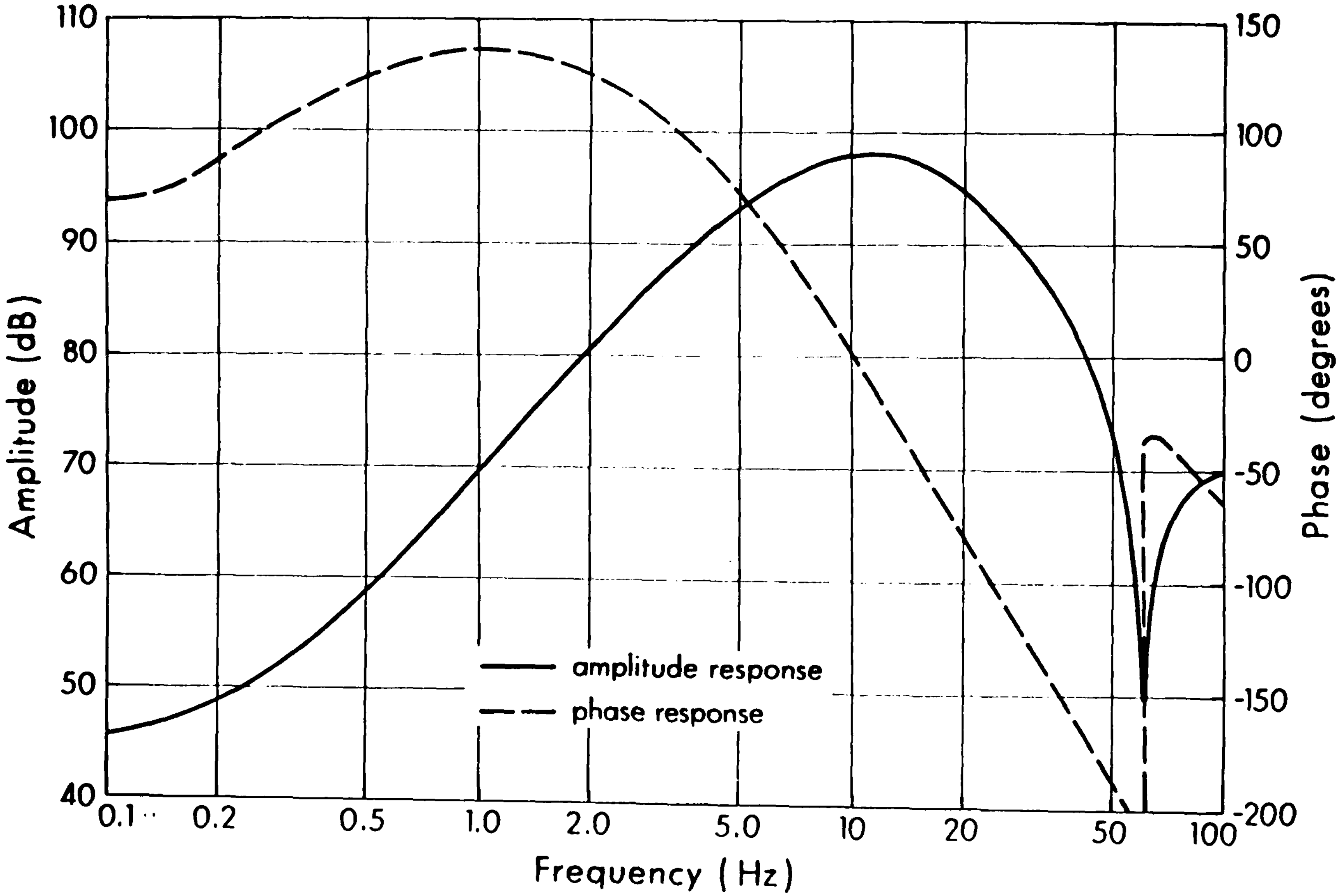


Figure 3. The response of the preamp/pre-whitening filters at gain step 9 (of 0-9). Subtract 3 dB from the amplitude response for each gain step down from 9.

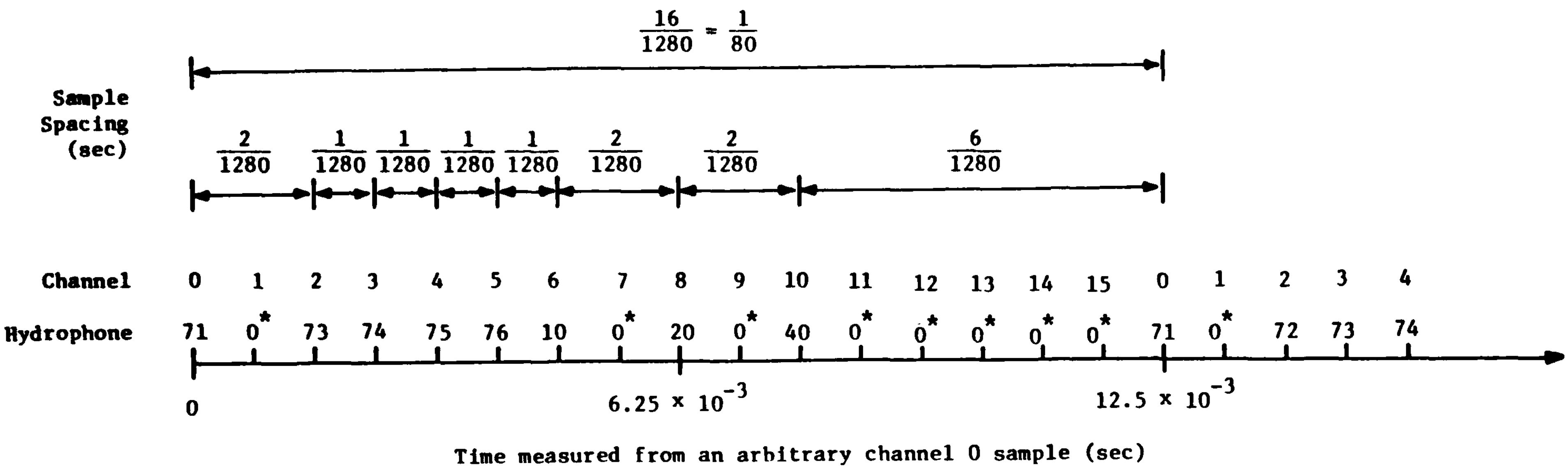


Figure 4. An example of the temporal spacing between data channels created by the data acquisition hardware and software for a sampling rate of 80 samples/second/channel. Hydrophones numbered 0 (also starred, *) are for unwanted data channels which are sampled by the A/D convertor but later discarded by the WAKEUP software. This channel/hydrophone information is written into the header part of each data block. The configuration shown is one which has been in use since the system was installed.

better than ±1 msec when the satellite signal is being received. The time, in Julian days through milliseconds, is output in parallel BCD format through 45 pins of a 50 pin connector. This connector also contains 4 pins for the clock status (i.e., the worst case clock accuracy based on the amount of time since satellite synchronization was lost), and 1 pin with a 1 kHz square-wave used to determine when the other pins can be read (i.e., are not changing states). Also output (on BNC connectors) are a 1 Hz square-wave used to synchronize A/D sampling with the clock, and a slow code used for marking time on the helicorder record.

A/D Sampling Pulse Generator (HIG built)

This device is used to create precisely timed pulses (downward zero-crossings) which are synchronized with the satellite clock and trigger A/D conversions. The front panel has thumbwheel selectors for setting the number of channels of data to be sampled (always 16 in this system due to the A/D convertor; software discards unwanted channels), and the sampling rate (in samples/sec/channel). For 16 channels of data, sampled at 80 samples/sec/channel, the pulse generator produces a 1280 Hz square-wave. A/D synchronization with the clock is necessary so that the starting times of output data blocks, which are assembled for a constant number of A/D conversions, will also remain synchronized over long periods of time.

Mounting Enclosure (DEC model BA11-NE)

The mounting enclosure contains the power supply, backplane (QBUS), and cooling fan for the LSI-11/2 computer. The backplane has quad connectors for nine boards, all of which are occupied in this system configuration.

These nine boards, and the order in which they are placed from top to bottom in the enclosure, are noted in Fig. 1.

LSI-11/2 Computer (DEC model KD11-HA)

This is the central processing unit of the computer.

64 K-byte memory (DEC model MSV11-DD)

This is the core memory for the computer, consisting of 32K 2-byte words.

Bootstrap module (DEC model BDV11-AA)

This module brings up the computer from a down or power fail status, and causes the RT-11 operating system to be loaded from the disk.

64 Bit I/O Controller (DEC model DRV11-J)

This board is necessary to interface the LSI-11/2 with the 50 pin output of the satellite clock. The 64 bits of I/O correspond to four two-byte words which may be accessed by the software to read the clock.

Floppy Disk Drive Controller (DEC model RXV21-BA)

This board interfaces the disk drive to the computer.

Dual 512K Byte Floppy Disk Drive (DEC model RXV21-BA)

The floppy disks contain all of the software necessary for performing data acquisition with the hardware. Under the present configuration, one disk contains the DEC RT-11 operating system software, while the other disk contains the programs written at HIG for collecting the data and a

parameters file which describes the exact configuration to be run (i.e., number of channels of data, blocksize, etc.). It is possible, should one disk drive become faulty, to combine all of the programs and data on one disk, and run from a single drive. A special function of the disk drive is to record the number of the current tape drive to which the data are being written. In the case of a power failure, which causes the core memory of the LSI-11/2 to be lost, the current tape drive number is necessary to safely and efficiently resume recording.

EIA Line Controller (DEC model DLV11-J)

This device provides four ports (0 to 3) for serial I/O (RS-232C, RS-422, or RS-423) to the LSI-11/2. Port 3 is the only one in use under the current operating configuration and interfaces to the DEC LA38-GA which is serving as both a line printer and operator console at 300 baud. Separate ports for the line printer and a CRT operator console were used during program development to facilitate higher baud rates.

Console and Printer (DEC model LA38-GA)

This device is used for all operator input and output (I/O) with the system, and for all program messages. Since there is actually very little I/O to this device, its slow speed is not a problem. Also, there is a distinct advantage in having a hardcopy record of certain essential I/O, especially since the system is at a remote site. Sample I/O is shown in Fig. 5.

Tape Controller and Formatter (DATUM model 15221)

```
WAKE HYDROPHONE ARRAY CONTINUOUS DIGITAL SEISMIC RECORDING SYSTEM

USING DRIVE 2            DATE 1983:153    TIME/08:06:00:000    CLOCK/00
USING TAPE     10781
DRIVE 2 END OF TAPE REACHED
        05820 BLOCKS WRITTEN
USING DRIVE 3            DATE/1983:153    TIME/18:10:59:999    CLOCK/00
USING TAPE     10782
DRIVE 3 END OF TAPE REACHED
        05824 BLOCKS WRITTEN
DRIVE 0 OFFLINE
USING DRIVE 1            DATE/1983:154    TIME/00:16:19:999    CLOCK/00
USING TAPE     10783
SWITCH DRIVES
DRIVE 1 05217 BLOCKS WRITTEN
```

```
WAKE HYDROPHONE ARRAY CONTINUOUS DIGITAL SEISMIC RECORDING SYSTEM

USING DRIVE 2            DATE 1983:154    TIME/07:31:04:999    CLOCK/00
USING TAPE     10784
DRIVE 2 END OF TAPE REACHED
        05824 BLOCKS WRITTEN
USING DRIVE 3            DATE/1983:154    TIME/15:36:24:999    CLOCK/00
USING TAPE     10785
DRIVE 3 END OF TAPE REACHED
        05804 BLOCKS WRITTEN
DRIVE 0 OFFLINE
USING DRIVE 1            DATE/1983:154    TIME/23:40:04:999    CLOCK/00
USING TAPE     10786
RESET-WAIT FOR MINUTE
DRIVE 1 06065 BLOCKS WRITTEN
```

```
WAKE HYDROPHONE ARRAY CONTINUOUS DIGITAL SEISMIC RECORDING SYSTEM

USING DRIVE 2            DATE 1983:155    TIME/08:11:00:000    CLOCK/00
USING TAPE     10787
DRIVE 2 END OF TAPE REACHED
        05822 BLOCKS WRITTEN
USING DRIVE 3            DATE/1983:155    TIME/16:16:10:000    CLOCK/00
USING TAPE     10788
DRIVE 3 END OF TAPE REACHED
        05807 BLOCKS WRITTEN
DRIVE 0 OFFLINE
USING DRIVE 1            DATE/1983:156    TIME/00:20:05:000    CLOCK/00
USING TAPE     10789
SWITCH DRIVES
DRIVE 1 05063 BLOCKS WRITTEN
```

Figure 5. A sample of 3 consecutive days of I/O through the console at Wake. Operator input has been underlined (S, R, and S). The operator writes-in the WAKEUP tape identification numbers.

The tape controller interfaces the tape drives with the LSI-11/2. Only one controller is necessary for the four tape drives used. The formatter encodes the blocks of data written to tape, and decodes the blocks read from the tape. Only one formatter is necessary for the four tape drives.

Tape Drives (DATUM model D451)

Four 1600 bpi tape drives (0-3) are available for writing out the digitized data. Data is written to one drive until its tape is full (or until a specified number of blocks have been written), then data is written to the next drive in the sequence until its tape is full, and so on. Four tape drives are required if tapes are changed only once per day, since one day's data (11 channels at 80 samples/sec/channel) fills four tapes. An important feature which these tape drives have, is that they re-tension the tape, advance the tape several inches for safety, and put themselves "on line" after a power failure. This is an important factor which allows the system to start collecting data again without operator intervention or the unnecessary loss of data.

2-5 Hz Filter (HIG built)

The two-channel 2-5 Hz bandpass filter is for filtering the two signals going to the drum recorder in a way which enhances signal to noise ratios of teleseismic P from underground nuclear tests. The filters are a two-pole passive RC design with the response shown in Fig. 6

Helicorder Amplifier and Drum Recorder (Teledyne Geotech models AR-311 and RV-301)

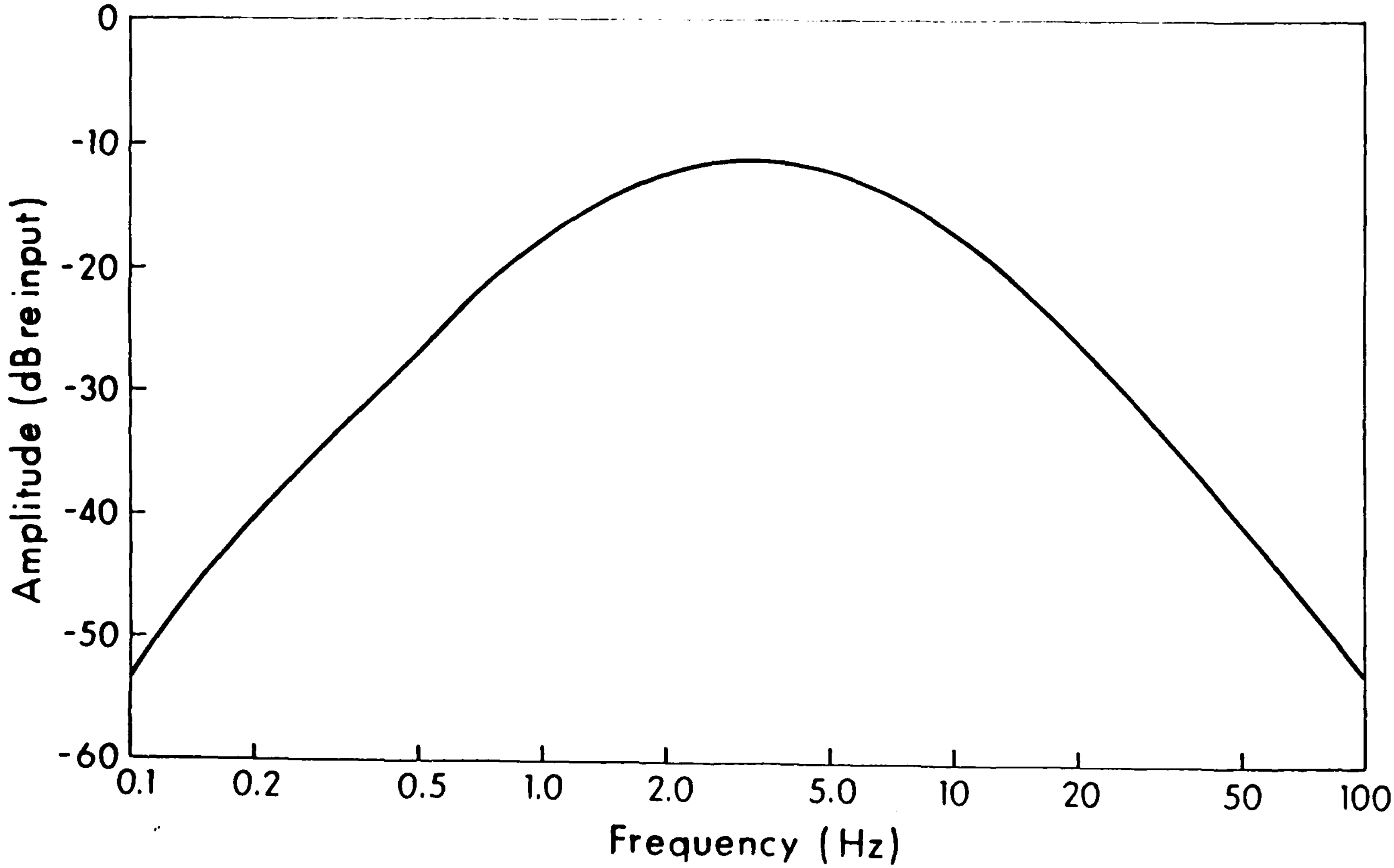


Figure 6. Response curve for the 2-5 Hz filter which precedes the helicorder.

This equipment is used to provide easily scanable visible records of the continuous seismic data. The recorder has two pens for the two input signals, and is geared so that one recording sheet lasts 24 hours. Additionally, the amplifiers and drum recorder are powered by a trickle charged, automobile battery backup system to provide continuous operation through power failures. Time code is input from the satellite clock. A sample helicorder record is shown in Fig. 7.

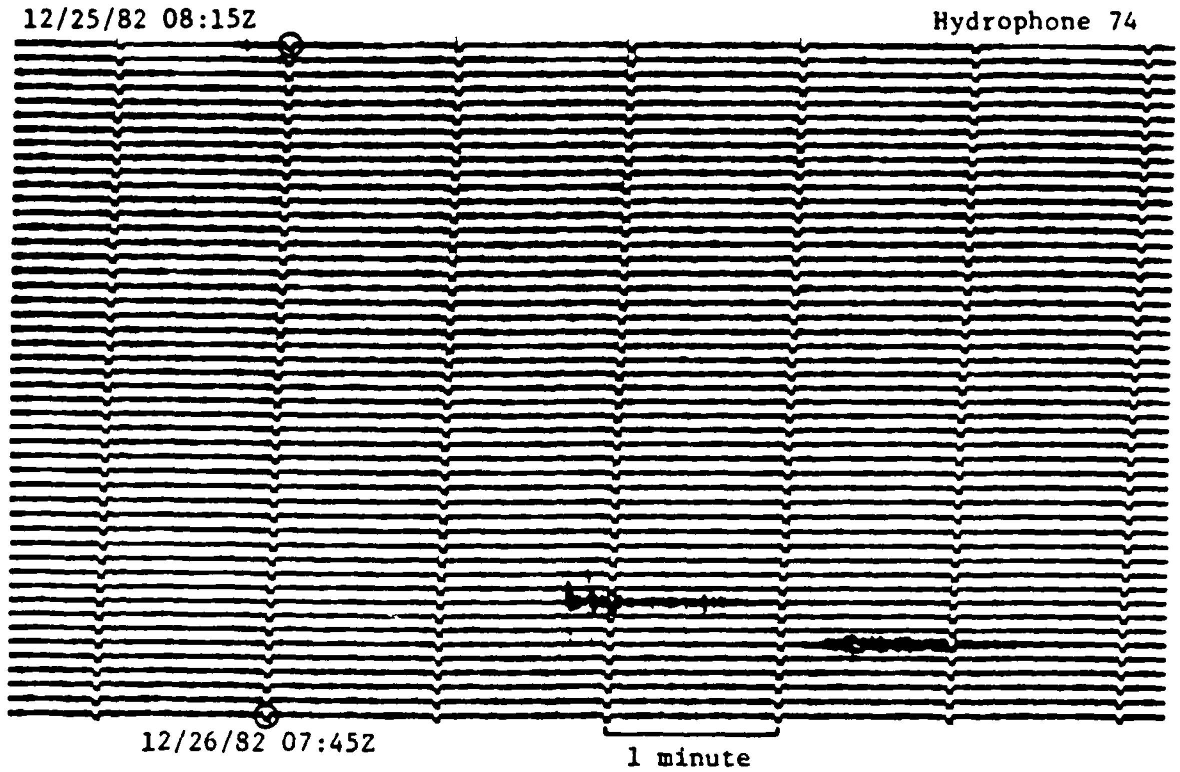
CONTINUOUS DATA ACQUISITION SOFTWARE

The data acquisition program, titled WAKEUP, is written in assembler code and executed under the RT-11 operating system. A simplified flow chart of this software is shown in Fig. 8. Some key features of program WAKEUP are: 1) it is controlled by an input parameters file which can be changed to satisfy differing data collection requirements; 2) it is extremely simple to run - only four, one-letter, operator commands (to be discussed later) are recognized; 3) it can restart itself after a power failure; and 4) it makes a hardcopy log of important program events.

WAKEUP Parameters

The WAKEUP running parameters can be displayed and changed by an interactive fortran program called PARAMS. A sample run of PARAMS is shown in Fig. 9. The parameters and their meanings are described below:

Digitization Rate. The value set here should be the same as the value set on the A/D sampling pulse generator for samples/sec/channel.



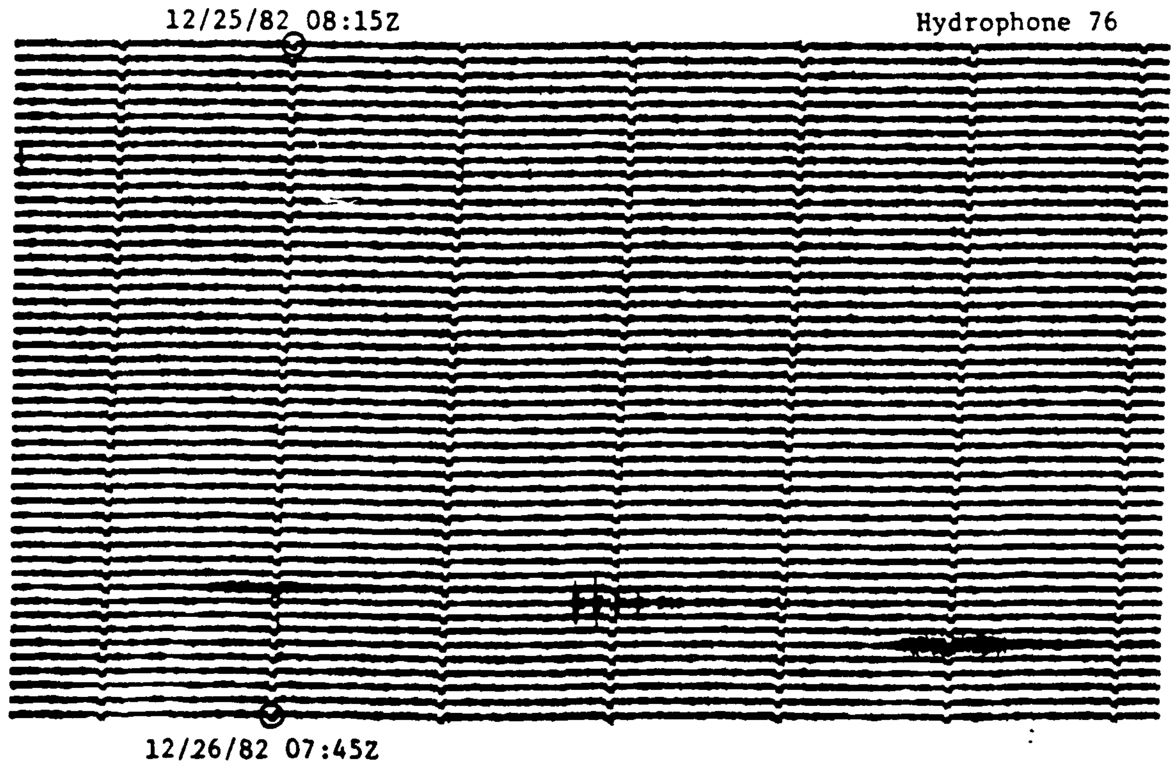


Figure 7. A section of helicorder record from Wake showing the P arrival from an Eastern Kazakh explosion (the impulsive arrival) and some other unidentified arrivals which are probably T-phases. There are 30 minutes between each trace.

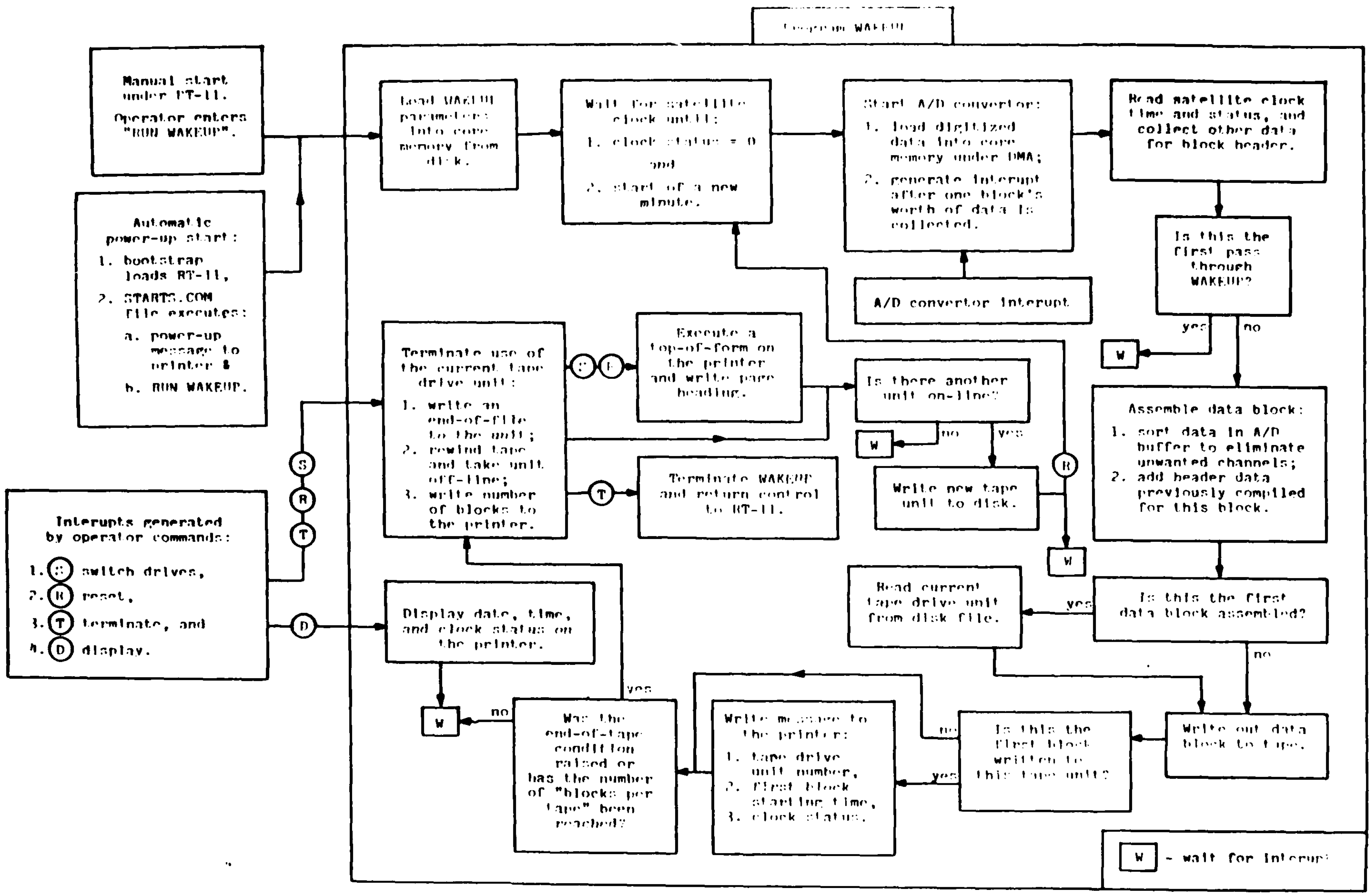


Figure 8. Generalized logic flow-chart of program WAKEUP which controls the data acquisition. The program is started either manually, or automatically after a power failure. The A/D convertor interupt has a high priority and is serviced immediately. The operator command interupts are low-priority and are serviced when the CPU is in the wait (W) condition. Paths marked S, R, T, or D are followed (only once) after the corresponding operator interupt is serviced. Three data buffers are used; two of them provide a double buffer for DMA output from the A/D convertor, and the third is used for assembling the data block to be output to tape.

```
.RUN PARAMS

PARAMS - SETTING WAKEUP PARAMETERS

CURRENT PARAMETER VALUES
DIGITIZATION RATE:  80 SAMPLES/CHANNEL/SEC
SECONDS PER TAPE BLACK:  5
CH  HYD  AMP  GN  CH  HYD  AMP  GN   CH  HYD  AMP  GN   CH  HYD  AMP  GN
 0   71    6   9   1   72    8   9    2   73    9   9    3   74    0   9
 4   75   19   9   5   76    1   9    6   10   13   9    7   11   16   9
 8   20   11   9   9   21    3   9   10   40   18   9   11    0    0   0
12    0    0   0  13    0    0   0   14    0    0   0   15    0    0   0
BLOCKS PER TAPE:  32000
UNIT - DRIVE SERIAL NUMBER:  0-318  1-319  2-322  3-326
STARTING TAPE UNIT NUMBER:  0
YEAR:  1982   JULIAN DAY:  250

ENTER COMMAND (8 TO DISPLAY COMMANDS).  8

COMMAND - FUNCTION
 0 - CHANGE DIGITIZATION RATE.
 1 - CHANGE SECONDS PER BLOCK.
 2 - CHANGE A/D CHANNEL ASSIGNMENTS.
 3 - CHANGE BLOCKS PER TAPE.
 4 - CHANGE TAPE UNIT SERIAL NUMBER.
 5 - CHANGE STARTING UNIT NUMBER.
 6 - CHANGE YEAR/JULIAN DAY.
 7 - DISPLAY CURRENT PARAMETER VALUES.
 8 - DISPLAY COMMAND FUNCTIONS.
 9 - UPDATE AND DISPLAY WKPARM AND RCOVRY.
10 - CHANGES COMPLETE.  UPDATE AND EXIT.

ENTER COMMAND (8 TO DISPLAY COMMANDS).  10

DK:WKPARM.BIN
 80     400     4400      71       69      72     89     73
 99      74        9      75      199      76     19     10
139      11      169      20      119      21     39     40
189       0        0       0        0       0      0      0
  0       0        0    6400    32000     318    319    322
326       5        0       0        0       0      0      0
DK:RCOVRY.BIN
  0    1982      250       0        0       0      0      0
  0       0        0       0        0       0      0      0
  0       0        0       0        0       0      0      0
  0       0        0       0        0       0      0      0
  0       0        0       0        0       0      0      0
  0       0        0       0        0       0      0      0
DK:WKPARM.BIN AND DK:RCOVRY.BIN UPDATED.

STOP --

.
```

Figure 9. A sample run of program PARAMS which is used to change (or view) the running parameters of program WAKEUP. These parameters are stored on disk files DK:WKPARM.BIN and DK:RCOVRY.BIN. Operator commands have been underlined.

Seconds Per Tape Block. This value, multiplied by the sampling rate and by the number of active data channels, will determine the total number of samples per block. The number of samples per block should not exceed 5000 due to size limitations in the core memory containing the buffers. Very small blocksizes should also be avoided, since the time to write a very small block to tape may exceed the time necessary to collect the data block.

Channel Number (CH). This is not a changeable parameter, but merely indicates which channel (0-15), of the A/D convertor, is being referred to.

Hydrophone (HYD). This parameter indicates which hydrophone (71-76 for the bottom array, and 10, 11, 20, 21, 40, and 41 for the SOFAR array) is connected to the A/D channel. If 0 is specified, then the channel is considered inactive. To compute the number of active channels, simply count the number of channels with non-zero values for this parameter (11 for the example in the figure). It is not necessary that the active channels be contiguous as shown in the figure.

Amplifier (AMP). This parameter indicates which of the preamp/pre-whitening filters (1-20) the hydrophone signal is connected to.

Gain (GN) . This parameter indicates the gain step (0-9) manually set on the final stage of the preamp/pre-whitening filters.

Blocks Per Tape. This parameter will set the number of blocks written to any tape drive before the next tape drive is used. When the value is set to a large number, as shown in the example, the program will write to a drive until the end-of-tape mark is sensed before switching drives. Estimates of how many blocks may fit on a tape can be computed by dividing the block length in bytes by 1600 bytes per inch, adding the length of the preamble, postamble and inter-record gap (~0.6 inches), and dividing into the tape length (28800 inches for a full-reel).

Unit-Drive Serial Number. This information is used to indicate which physical tape drive is connected to the tape drive unit (0-3) recognized by the computer.

Starting Tape Unit Number. This parameter is used to determine which tape drive to write to at the start of program WAKEUP. It is continually updated by WAKEUP to facilitate a smooth recovery after a power failure.

Year and Julian Day - These parameters are necessary because the satellite clock does not output the year. WAKEUP continually reads the Julian day from the parameters file and then updates it with the value ouput by the satellite clock. When the satellite clock Julian day is less than the Julian day in the parameters file (i.e., at the beginning of a new year), then the year is incremented by one.

Next in the example shown in Fig. 9, the user has typed 8 to display all the commands. No changes were necessary so a 10 was then typed to exit PARAMS.

The values in the parameters file (actually two files, DK:WKPARM.BIN and DK:RCOVRY.BIN) are displayed and control returned to the system.

Current WAKEUP Configuration

The WAKEUP configuration, set up by PARAMS, which has been in operation from 8 September 82 to the present (16 June 83) has the following key features: 1) data is digitized at a rate of 80 samples/sec/channel; 2) there are 8 active channels which are (given in the order in which they are multiplexed) 71, 73, 74, 75, 76, 10, 20, and 40 as previously described in Fig. 4; 3) each block contains 5 seconds of data which produces a block size of 3300 2-byte words (i.e., 3200 words of data plus a 100 word block header) and 4) the number of blocks per tape is large so that tapes are always written to their end-of-tape marks. Although it had been intended to digitize and record 11 hydrophones, which would produce 4 tapes per day, assorted problems with the tape drives have made it necessary to only record 8 hydrophones, which produces 3 tapes per day.

WAKEUP Operator Commands

Because Wake Island is such a remote place, and because those who must operate the system are untrained in computer hardware or software, program WAKEUP has been designed to handle many unusual situations without operator intervention. Only four operator commands are necessary during continuous data collection under WAKEUP, and these are described below:

Switch Drives(S). This command is used to force WAKEUP to write to the next available tape drive. This command is normally executed once per day when the operator comes in to change tapes. First he changes tapes on

those drives which have tapes full of data, and allows WAKEUP to continue writing onto the current drive. When fresh tapes are mounted, he executes the S, which causes WAKEUP to start writing to a fresh tape, and then he changes tapes on that last drive. A sample of S is shown in Fig. 5.

Reset(R). The reset command is nearly identical to the switch drives command, except that WAKEUP will wait for the satellite clock to indicate a change in the minute before it starts the A/D convertor collecting data for the next block. It is desirable to have data blocks which start on an integral second, (or integral minute) because it makes the measurement of time on plots, made later on during data reduction, somewhat simpler. Under ideal conditions, once the block beginnings are synchronized with the minute (i.e., if the number of seconds per block is 5, then all blocks should begin at 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, or 55 seconds after the minute) they should stay that way forever. Unfortunately, the satellite clock sometimes loses synchronization with the satellite for a while and begins to drift. When resynchronization occurs, the accumulated error gets propagated into the starting times of the blocks. When the operator notices this condition, he can correct it by using reset instead of switch drives. A sample of R is shown in Fig. 5.

Terminate (T). This command is used to terminate WAKEUP and return control to the RT-11 operating system.

Display (D). This command is used to display the date, time, and clock status at the beginning of the last data block collected.

Power Fail Recovery

Probably the most harmful abnormal condition, in terms of potential loss of data, from which WAKEUP can recover without operator intervention is a power failure. Temporary periods without power are fairly common on Wake and can be due to storms, construction, and generator problems. Since an operator is only present once per day, an irrecoverable system crash due to a short power failure could cause the loss of the entire day's data. Fortunately, with the help of some unique features in the Datum tape drives (described previously), the DEC LSI-11/2 hardware, and the RT-11 operating system, it was possible to write the WAKEUP program with the capability to resume collecting data after a power failure, without wasting tape (which could cause the system to run out of tape before the operator arrived) and without writing over old data. An essential element of this recovery capability is that the particular tape drive being written to is stored on a disk file. When power comes back after a failure, WAKEUP reads this file and then resumes writing to the proper drive.

WAKEUP Log

All operator input as well as RT-11 and WAKEUP messages and operator prompts go through the printer/console to create a log of events. A sample of this log is shown in Fig. 5, and has already been referred to several times. This log is essential for keeping track of normal system operations as well as problems which occur from time to time. The operator is

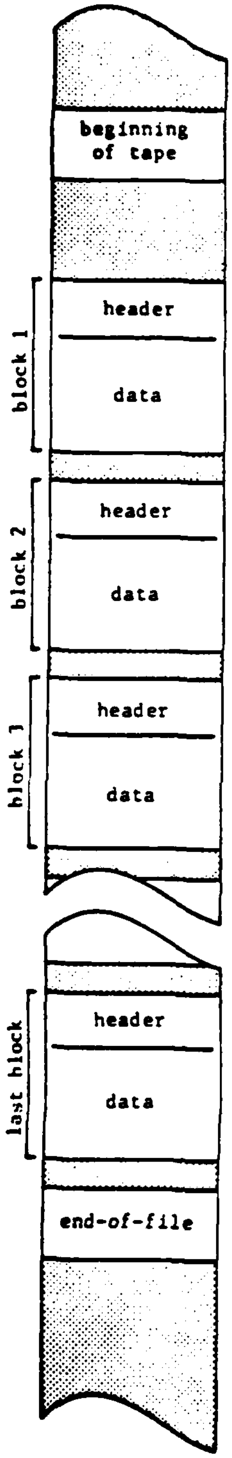
responsible for filling in the identification numbers of tapes mounted on each drive.

WAKEUP Tape Format

The WAKEUP tapes are numbered sequentially beginning with 10001. A detailed description of the format of the tapes and the blocks contained within the tapes is given in Fig. 10. The date and time given in the header are for the first data point in the block.

PRELIMINARY DATA REDUCTION SOFTWARE - WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS)

Because of the large amount of data which is collected by this system (i.e., 50 billion bytes per year or 1500 tapes per year for 11 channels at 80 samples/sec/channel) it was realized that some sort of data compression scheme would have to be implemented in order to efficiently store, manage, retrieve, and distribute those data of current and future interest. These data have been defined in two general categories: 1) seismic phases such as P. S, Po, So, and T, and 2) ambient background noise. Software to sample these categories has been written and its structure is diagramed in the flow chart of Fig. 11. Intervals of data are saved when seismic phases from particular events are suspected of being present; and, in addition, 3-minute intervals of data selected at random times, with an average of one interval per hour, are also saved in order to sample the ambient noise. Three minutes of data is long enough to view several cycles at the longest periods thus far observed on the hydrophones - 20 seconds, and also long enough to provide reasonable statistics on the higher frequencies (1-20 Hz) where most of the oceanic, short-period seismic data are present. By sampling at



WAKEUP Tape Description

General Format: 1600 BPI
2 bytes per word
IBM format
2's complement notation

All Blocks	
header: words 1-100 data: words 101-end	
Word(s)	**Description**
1	Year (e.g., 1983)
2	Julian day (1-366)
3	Hour
4	Minute
5	Second
6	Millisecond
7	Digitization rate (samples/sec/channel)
8	Number of samples/channel/block
9	Total number of samples/block
10-41	A/D channel information - 16 channels, 2 words per channel 1st word - hydrophone I.D. number (0 if channel not used) 2nd word - hundreds and tens digit is the amplifier I.D. number, units digit is the amplifier gain step
42	Tape unit (0-3)
43	Tape drive serial number
44	Clock status
45	A/D buffer size
46-100	Not used
101-end	Digitized hydrophone data (multiplexed-order of hydrophones is the same as the order of the active channels described in words 10-41)

Figure 10. The WAKEUP tape format.

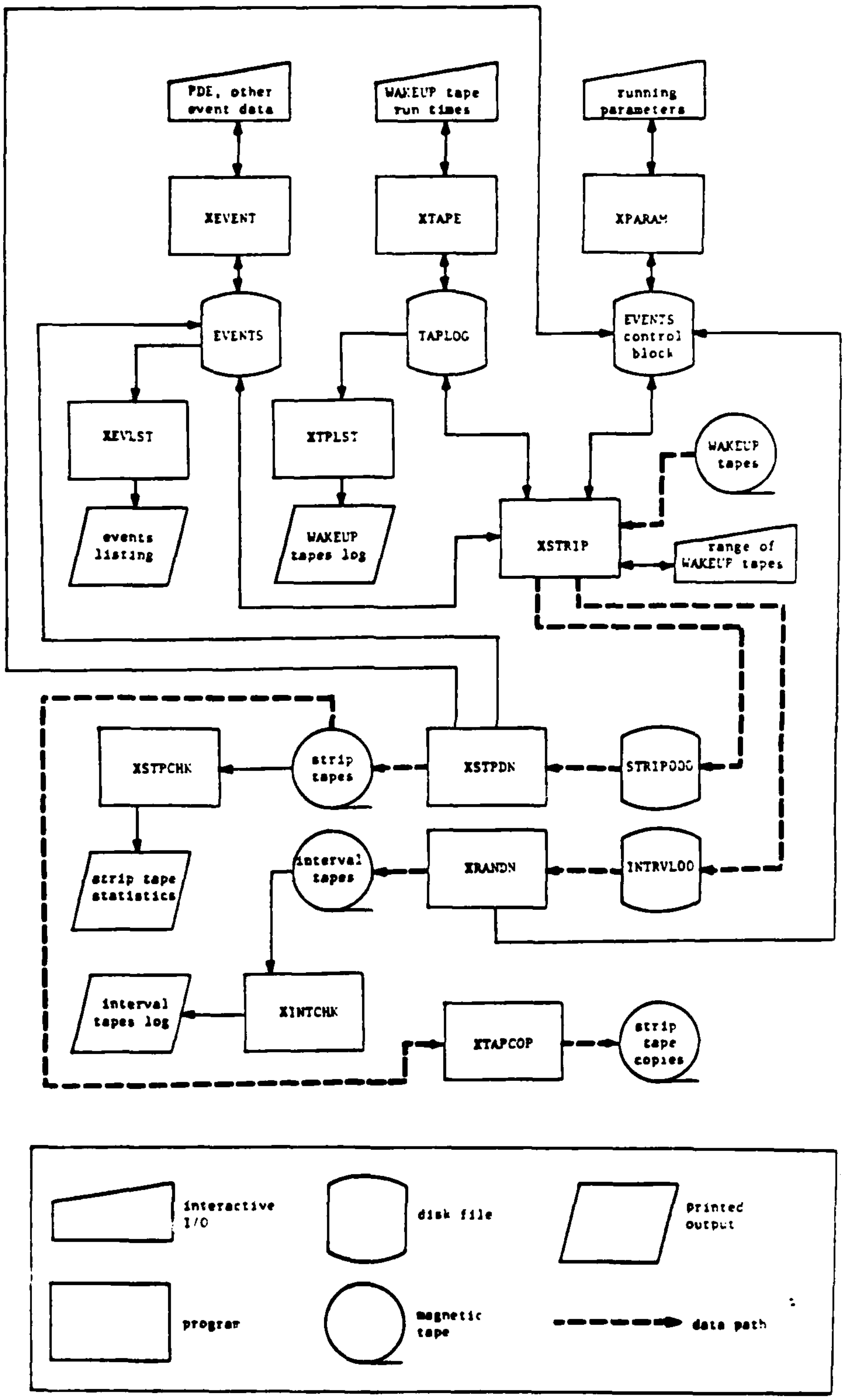


Figure 11. Generalized flow chart of the programs and files used in the preliminary reduction of the Wake digital data.

random time intervals, periodic noise of artificial nature is hopefully avoided. This system of programs and files which performs processing of the WAKEUP data is called WHIPS for Wake Hydrophone Information Processing System, and is run on a Harris model H800 computer.

WAKEUP Log Entry (XTAPE)

An initial step in the WHIPS procedure is to create or update file TAPLOG, which contains an identification number, starting time, block count, and status of each tape created by WAKEUP. This information is entered from the WAKEUP log (Fig. 5), using interactive program XTAPE. The data is necessary, as input to program STRIP, for calculating the time window to be processed for the compression of a given range of WAKEUP tape. Some sample data contained in TAPLOG, and printed out using program XTPLST is shown in Fig. 12. The total time represented on an individual tape can be found by multiplying the number of blocks by the number of seconds per block (which is 5 seconds per block for the tapes shown). The tape status indicates whether the tape is available for current or further processing (ACTIVE), or has been recycled (RECYCL).

Event Data Entry (XEVENT)

Another initial step in the WHIPS procedure is to create or update file EVENTS, which contains data about each earthquake for which an interval of data is to be saved. A sample of data contained in this file has been listed using program XEVLST and is shown in Fig. 13. Hypocenter/origin-time data are taken mostly from the Preliminary Determination of Epicenter (PDE) lists, published by the National Earthquake Information Service (NEIS), although other sources of data are used to complement the PDE's when

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WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM

WAKEUP TAPE LOG LIST

TAPE#	----START YR	 JLN	 HR	TIME---- MN	 SC	 MIL	#BLKS	STATUS
10561	83	076	05	27	25	000	5783	ACTIVE
10562	83	076	13	29	20	000	5791	ACTIVE
10563	83	077	05	12	40	000	5766	ACTIVE
10564	83	077	13	13	10	000	5824	ACTIVE
10565	83	078	05	15	15	000	5922	ACTIVE
10566	83	078	13	28	45	000	5829	ACTIVE
10567	83	079	04	34	45	000	5862	ACTIVE
10568	83	079	12	43	15	000	5796	ACTIVE
10569	83	080	05	17	25	000	5857	ACTIVE
10570	83	080	13	25	30	000	5805	ACTIVE
10571	83	081	06	15	50	000	5874	ACTIVE
10572	83	081	14	25	20	000	5827	ACTIVE
10573	83	081	22	30	55	000	4895	ACTIVE
10574	83	082	05	18	50	000	5860	ACTIVE
10575	83	082	13	27	10	000	5787	ACTIVE
10576	83	082	21	29	25	000	5605	ACTIVE
10577	83	083	05	16	30	000	5755	ACTIVE
10578	83	083	13	16	05	000	5805	ACTIVE
10579	83	083	21	19	50	000	5696	ACTIVE
10580	83	084	05	14	30	000	5856	ACTIVE

Figure 12. A sample of the WAKEUP tape information contained within WHIPS file TAPLOG which has been printed using program XTPLST. A detailed description of this printout is contained in the text.

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 22 JUN 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT NO	YR	MO	DA	JUL	HR:MN:SECS	LAT	LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	MAGNI SRF	INF SRC	EV TP	PHASES	SAVED INTERVAL	MNS	STRIP TAPE/FILE
0001	83	03	19	078	22:59:47.1	4.826S	153.812E	NEW IRELAND REGION	119	4.8	0.0	PDE	EQ	ABD	23:00-23:15	15	20042/-11
0002	83	03	20	079	11:24:48.4	2.37[illegible]N	126.800E	MOLUCCA PASSAGE	58	5.5	4.0	PDE	EQ	A	11:28-11:39	12	20042/ 12
0003	83	03	20	079	13:45:49.8	4.72[illegible]S	153.125E	NEW IRELAND REGION	86	5.9	0.0	PDE	EQ	ABDF	13:46-14:27	42	20042/ 13
0004	83	03	20	079	16:24:13.3	18.8[illegible]7S	177.762W	FIJI ISLANDS REGION	61[illegible]	5.0	0.0	PDE	EQ	A	16:26-16:37	12	20042/ 14
0005	83	03	20	079	17:44:07.1	18.804S	177.679W	FIJI ISLANDS REGION	614	4.9	0.0	PDE	EQ	A	17:46-17:57	12	20042/ 15
0006	83	03	21	080	04:06:24.8	5.031S	153.698E	NEW IRELAND REGION	[illegible]	5.5	0.0	PDE	EQ	ABDE	04:07-04:48	42	20042/-16
0007	83	03	21	080	07:44:17.6	21.668S	175.3[illegible]W	TONGA ISLANDS	7[illegible]	6.3	0.0	PDE	EQ	A	07:47-07:59	13	20042/ 17
0008	83	03	21	080	07:57:18.4	7.34[illegible]S	128.9[illegible]E	BANDA SEA	14[illegible]	5.6	0.0	PDE	EQ	A	08:00-08:12	13	20042/ 17
0009	83	03	21	080	15:23:40.7	36.5[illegible]N	70.593E	HINDU KUSH REGION	16[illegible]	4.2	0.0	PDE	EQ	A	15:31-15:42	12	20042/ 18
0010	83	03	21	080	15:49:52.8	21.394S	175.452W	TONGA ISLANDS	70	5.4	0.0	PDE	EQ	A	15:53-16:04	12	20042/ 19
0011	83	03	22	081	01:32:28.6	51.297N	178.481W	ANDREANOF ISL. ALEUTIAN ISL.	33	4.9	0.0	PDE	EQ	ABD	01:34-01:50	17	20042/-20
0012	83	03	22	081	20:17:07.5	53.211N	162.259E	OFF EAST COAST OF KAMCHATKA	33	4.7	0.0	PDE	EQ	ABD	20:19-20:35	17	20042/ 21
0013	83	03	23	082	06:09:29.6	6.618S	154.612E	SOLOMON ISLANDS	41	5.7	6.2	PDE	EQ	ABDE	06:10-06:52	43	20042/ 22
0014	83	03	23	082	06:40:32.1	6.663S	154.559E	SOLOMON ISLANDS	5[illegible]	5.2	0.0	PDE	EQ	ABDE	06:41-07:23	43	20042/ 22
0015	83	03	23	082	08:26:55.2	6.627S	154.585E	SOLOMON ISLANDS	[illegible]	5.4	5.6	PDE	EQ	ABDE	08:28-09:09	42	20042/ 23
0016	83	03	23	082	12:11:23.9	37.011N	71.487E	AFGHANISTAN USSR BORDER REGION	1[illegible]	5.2	0.0	PDE	EQ	A	12:18-12:30	13	20042/ 24
0017	83	03	23	082	14:04:58.1	6.782S	154.528E	SOLOMON ISLANDS	6[illegible]	5.2	0.0	PDE	EQ	ABDE	14:06-14:47	42	20043/ 01
0018	83	03	23	082	15:07:01.2	3.375S	172.491E	GILBERT ISLANDS REGION	2[illegible]	4.8	0.0	PDE	EQ	ABD	16:07-16:21	15	20043/ 02
0019	83	03	23	082	21:54:36.3	37.224N	138.125E	NEAR W COAST OF HONSHU JAPAN	54	4.6	0.0	PDE	EQ	ABD	21:56-22:11	16	20043/ 03
0020	00	00	00	000	00:00:00.0	0.000N	0.000E	LOCAL PO. SO. T	0	0.0	0.0	HEL	EQ	BDE	00:22-00:51	30	20043/ 04
0021	83	03	24	083	07:01:40.9	10.551S	159.8[illegible]E	SOLOMON ISLANDS	151	4.9	0.0	PDE	EQ	ABD	07:03-07:18	16	20043/ 05
0022	83	03	24	083	07:24:12.5	7.615S	107.173E	JAVA	5[illegible]	4.9	0.0	PDE	EQ	A	07:30-07:41	12	20043/ 06
0023	83	03	24	083	09:44:53.9	6.602S	154.564E	SOLOMON ISLANDS	5[illegible]	5.1	0.0	PDE	EQ	ABDE	08:46-09:27	42	20043/ 07
0024	83	03	24	083	10:47:40.5	4.721S	153.336E	NEW IRELAND REGION	8[illegible]	5.2	0.0	PDE	EQ	ABDE	10:48-11:29	42	20043/ 08
0025	83	03	24	083	12:24:35.2	10.814S	163.9[illegible]E	SOLOMON ISLANDS	74	4.9	0.0	PDE	EQ	ABD	12:25-12:41	17	20043/ 09
0026	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO. SO. T	0	0.0	0.0	HEL	EQ	BDF	20:10-20:39	30	20043/ 10
0027	83	03	25	084	07:44:01.2	6.555S	130.006E	BANDA SEA	164	5.4	0.0	PDE	EQ	A	07:47-07:58	12	20043/ 11
0028	83	03	25	084	13:00:14.2	6.494S	151.722E	NEW BRITAIN REGION	4[illegible]	5.3	0.0	PDE	EQ	ABDE	13:01-13:44	44	20043/ 12
0029	83	03	25	084	19:33:54.1	8.395S	124.680E	TIMOR	169	4.8	0.0	PDE	EQ	A	19:37-19:49	13	20043/ 13
0030	83	03	25	084	21:41:54.8	6.490S	155.118E	SOLOMON ISLANDS	1[illegible]	5.1	0.0	PDE	EQ	ABDE	21:42-22:24	43	20043/ 14
0031	83	03	26	085	10:51:48.4	39.130N	44.5[illegible]E	N.W. IRAN-USSR BORDER REGION	[illegible]	4.6	0.0	PDE	EQ	A	11:08-11:20	21	20043/ 15
0032	83	03	26	085	12:46:47.7	5.105S	153.59[illegible]E	NEW IRELAND REGION	7[illegible]	4.9	0.0	PDE	EQ	ABD	12:47-13:02	16	20043/ 16
0033	83	03	26	085	14:57:49.3	1.167N	126.586E	MOLUCCA PASSAGE	7	5.[illegible]	0.0	PDE	EQ	A	15:01-15:12	12	20043/ 17
0034	83	03	26	085	17:19:37.5	4.631S	141.8[illegible]E	PAPUA NEW GUINEA	10[illegible]	4.5	0.0	PDE	EQ	ABD	17:21-17:37	17	20043/ 18
0035	83	03	26	085	18:42:46.8	42.047N	141.79[illegible]E	HOKKAIDO JAPAN REGION	88	4.4	0.0	PDE	EQ	ABD	18:44-19:00	17	20043/ 19
0036	83	03	26	085	20:20:00.0	37.301N	116.46[illegible]W	SOUTHERN NEVADA	0	5.1	0.0	PDE	N	A	20:26-20:37	12	20044/ 01
0037	83	03	27	086	02:42:41.4	34.260N	92.644E	QINGHAI PROVINCE CHINA	3	4.5	0.0	PDE	EQ	A	02:48-03:00	13	20044/ 02
0038	83	03	27	086	09:04:33.5	27.514N	141.378E	BONIN ISLANDS REGION	[illegible]	4.8	0.0	PDE	EQ	ABD	09:05-09:19	15	20044/ 03
0039	83	03	27	086	18:32:00.1	4.838S	153.560E	NEW IRELAND REGION	9[illegible]	4.9	0.0	PDE	EQ	ABD	18:33-18:47	15	20044/ 04
0040	83	03	27	086	20:05:07.6	6.893S	148.454E	NEW BRITAIN REGION	3[illegible]	5.0	0.0	PDE	EQ	ABDE	20:06-20:51	46	20044/ 05
0041	83	03	28	087	19:17:58.8	26.306N	127.311E	RYUKYU ISLANDS	6[illegible]	5.1	0.0	PDE	EQ	A	19:20-19:31	12	20044/ 06
0042	83	03	28	087	23:38:27.2	12.985N	146.354E	SOUTH OF MARIANA ISLANDS	[illegible]	4.7	0.0	PDE	EQ	ABD	23:38-23:51	14	20044/ 07
0043	83	03	29	088	04:53:09.4	30.443N	131.500E	KYUSHU JAPAN	33	4.9	0.0	PDE	EQ	ABD	04:55-05:11	17	20044/ 08
0044	83	03	29	088	22:55:47.8	6.984S	154.807E	SOLOMON ISLANDS	[illegible]	5.1	0.0	PDE	EQ	ABDE	22:57-23:38	42	20044/ 09
0045	83	03	30	089	00:49:09.9	1.57[illegible]N	122.51[illegible]E	MINAHASSA PENINSULA	4[illegible]	5.1	5.1	PDE	EQ	A	00:53-01:04	12	20044/ 10
0046	83	03	30	089	06:46:22.5	40.001N	75.[illegible]E	KIRGHIZ-XINJIANG BORDER REGION	[illegible]	4.9	4.9	PDE	EQ	A	06:53-07:05	13	20044/ 11
0047	83	03	30	089	12:02:52.3	6.637S	154.560E	SOLOMON ISLANDS	[illegible]	4.8	0.0	PDE	EQ	ABD	12:04-12:18	15	20044/ 12
0048	83	03	30	089	16:13:15.2	39.884N	75.4[illegible]E	SOUTHERN XINJIANG CHINA	3[illegible]	4.6	0.0	PDE	EQ	A	16:21-16:32	12	20044/ 13
0049	83	03	30	089	18:55:49.1	5.919S	14[illegible].2[illegible]E	PAPUA NEW GUINEA	[illegible]	5.[illegible]	0.0	PDE	EQ	ABDE	18:58-19:46	49	20044/ 14
0050	83	03	31	090	13:24:45.6	34.281N	135.8[illegible]E	NEAR S COAST OF SOUTH HONSHU	3[illegible]	4.9	0.0	PDE	EQ	ABDE	13:25-14:11	47	0/ 00

Figure 13. A sample of event information contained within WHIPS file EVENTS, which has been printed using program XEVLST. A detailed description of this printout is contained in the text.

necessary. A general procedure has been formulated for determining which events from the PDE lists might produce seismic energy observable at Wake, based on experience gained from scanning the analog data collected since 1979. An outline of event types and their corresponding phases is presented in Fig. 14. Intervals to save for these events and phases are computed automatically by program XEVENT, at the time the hypocenter data are entered, and may be altered manually if necessary. The only seismic energy from events which is deliberately discarded is that of T-phases from smaller magnitude and unknown events. T-phase energy is generally so abundant (it is estimated that at least 10 times as many circum-Pacific events may be detected using T-phases than may be detected using other seismic phases) that very little data compression would be possible if all of these T-phase data were saved. This procedure is weighted towards saving more data than necessary (i.e., many of these events may not have observable energy at Wake, but this is hard to determine without scanning all the channels in particular frequency bands) so that a) unusual events are not discarded, b) data from small events may be enhanced with array processing, and c) data from events which are not of current interest but may be of future interest are saved. The helicorder records from Wake are also scanned for seismic phases such as P, Po, S, and So which do not correspond to known events, and intervals are saved to capture these phases. Two such intervals, corresponding to events 820 and 826, appear in Fig. 13. The final column of the listing shown in Fig. 13 gives the strip tape and file number which contains the corresponding interval of data. Some data intervals are contiguous or overlap and have therefore been saved in a single file (for example: events 807 and 808, and events 813 and 814). Other events have not yet been extracted from the WAKEUP tapes and are noted

Source Region(s)	Magnitude	Depth(km)	$\sim\Delta$	Phases
1. Nuclear Explosions Anywhere	all	all	0°-35°	P.Po.So.T
	all	all	$> 35^\circ$	P
2. Mariana Is., Bonin Is., Volcano Is., Honshu, and Gilbert Islands	$m_b < 5.0$	<100	18°-25°	P.Po.So
	$m_b > 5.0$	<100	18°-25°	P.Po.So.T
	all	>100	18°-25°	P.Po.So.T
3. Kuril Is., Kamchatka, Aleutian Is., New Guinea, New Britain, Solomon Is., and Santa Cruz Islands	$m_b > 5.0$	<100	25°-35°	P.Po.So.T
	all	>100	25°-35°	P.Po.So.T
4. Asian Continent	$m_b > 4.5$	all	30°-90°	P
5. Mid Pacific Plate Events	all	all	0°-35°	P.Po.So.T
	$m_b > 4.5$	all	$>35^\circ$	P.Po.So.T
6. Not Regions 2, 3, 4, or 5.	$m_b > 5.0$	all	$<90^\circ$	P
7. Mid Atlantic Antipode	all	all	340°-360°	P
8. Anywhere	$M > 6.0$	all	all	P
	$m_b > 6.5$	all	340°-360°	P

Figure 14. The general criteria used for deciding which phases (if any) to save for a known event. Time intervals which contain those phases are computed automatically by XEVENT or may be entered manually.

by a tape and file number of 0 (such as event 850). Some events, such as 801, 806, and 811, could not be extracted because there was no WAKEUP data available (in this case, due to a tape drive failure at WAKE). A file for these events, containing only header and trailer records, exists on the strip tape indicated, and the file number has been flagged as negative on the XEVLST listing.

XSTRIP Parameters (XPARAM)

The last initial step in the WHIPS procedure is to set up the running parameters for program XSTRIP which are stored in the header block of the EVENTS file. These parameters may be viewed and changed using program XPARAM, and a sample output from this program is shown in Fig. 15. Many of these parameters (D, E, F, G, H, and I) are continually updated by programs XSTRIP, XSTPDN, and XRANDN; and these parameters may be changed manually when necessary. Other parameters (A, B, and C) must always be entered and changed manually as the situation warrants. The "WAKEUP tape record length" (A) is equal to the WAKEUP sampling rate times the number of channels, times the number of seconds per block, plus 100 words for the block header (i.e., [80 x 8 x 5] + 100 = 3300). The "strip/interval disk record length" (A) is the block length used for disk files STRIP000 and INTRVL00; and it must be a multiple of 112 words (Harris sector size = 112 words) which is greater than or equal to the WAKEUP tape record length. The "maximum records ..." (B) is a conservative estimate of how many blocks of data (in this case, 3300 word blocks), will fit onto a tape created by XSTPDN or XRANDN. This parameter is necessary for XSTPDN to organize its output data so that individual intervals which are saved do not cross XSTPDN tape boundaries. The "seconds per WAKEUP tape block" (C) is used to convert terms which refer to a

```
WHIPS-->DEFINE SYSTEM PARAMETERS.

A.   WAKEUP TAPE RECORD LENGTH IS                        3300
     STRIP/INTERVAL DISC RECORD LENGTH IS                3360
B.   MAXIMUM RECORDS ON EVENT/INTERVAL TAPE IS           5580
C.   SECONDS PER WAKEUP TAPE BLOCK IS                       5
D.   NEXT WAKEUP TAPE TO STRIP IS                       10588
     LAST WAKEUP TAPE TO STRIP IS                           0
E.   LAST RECORD ON STRIP DISC FILE IS                      0
F.   CURRENT STRIP TAPE NUMBER IS                       20044
     LAST FILE WRITTEN IS                                   5
     NUMBER OF TAPE RECORDS IS                           1222
G.   LAST RECORD ON INTERVAL DISC FILE IS                   0
H.   CURRENT INTERVAL TAPE NUMBER IS                    30029
     NUMBER OF TAPE RECORDS IS                           3856
I.   RANDOM INTERVAL          2626668000000      2626668179995

ENTER A-J, U (UPDATE), OR X (EXIT).
```

Figure 1[illegible]. A part of the interactive I/O generated by WHIPS program XPARAM which is used to view or change the running parameters of program XSTRIP. More detailed explanation of these parameters is given in the text.

particular block on a WAKEUP tape into absolute times (for example - to calculated the ending time of a WAKEUP tape, given its starting time and total number of blocks). The "next" and "last WAKEUP tape to strip" (D) refers to the range of WAKEUP tapes which are to be processed during a particular run of XSTRIP. These parameters are continually updated during the XSTRIP run to facilitate recovery in case of a system crash. At the completion of the run, the last tape which was processed becomes the "next WAKEUP tape to strip", and the "last WAKEUP tape to strip" is set to 0, as shown in the figure. The "last record on the strip disk file" (E) allows XSTRIP to begin writing into STRIP000 where it last left off. This parameter is set to 0 after a successful downloading of the data using XSTPDN, as is shown in the figure. The "current strip tape", "last file", and "number of tape records" (F), allows XSTPDN to download the data onto tape from the point on the tape at which it left off after the last run. G and H serve the same function for the random interval data as did E and F for the stripped events data. The "random interval" (I) gives the 3 minute time range, in century-milliseconds, of the next random interval to be stripped.

Extracting the data (XSTRIP)

XSTRIP is the program which extracts and stores data of events and of random intervals on disk for later downloading. The only operator input required is specification of the range of WAKEUP tapes to be processed. Normally, this processing takes place in contiguous chronological order. After the total time interval represented by the WAKEUP tapes has been computed from the TAPLOG file, a search of the EVENTS file is made to determine which event intervals, not yet extracted, lie entirely within the

total time interval. From these individual event intervals, grand intervals are computed which combine the times of overlapping event intervals. As the WAKEUP tapes are read one by one (the operator is prompted to mount each tape), the grand intervals are extracted and stored on disk file STRIP000. Concurrently, the random, three-minute intervals are being extracted and stored on disk file INTRVL00. The timing of these intervals is computed "on the fly" and the number of minutes of data between the beginnings of one 3-minute interval and the next is computed using a random variable with a uniform distribution between 3 (i.e., no overlap) and 117, giving an average separation of 60 minutes. The parameters list at the beginning of the EVENTS file is updated after the extraction of each grand interval and each random interval. This facilitates a smooth and efficient recovery after an XSTRIP abortion of any kind and provides information for later downloading of the data to tape. XSTRIP is complete after the last WAKEUP tape has been run. It should be noted that a typical XSTRIP run at HIG processes from 10 to 20 WAKEUP tapes, and requires approximately 20 million words of disk storage for the STRIP000 and INTRVL00 files.

Events Download to Strip Tapes (XSTPDN)

The STRIP000 disk file containing the event data is downloaded to tape using program XSTPDN. This program first accesses the running parameters in the EVENT file to find out which tape to download to, and how many files to advance into that tape before writing. As each grand interval in the STRIP000 file is downloaded to tape, the running parameters are updated, and the EVENTS file is updated with the strip tape number and file for those events contained in the grand interval. If the grand interval contains too many records to completely fit on the strip tape (based on "B" in the

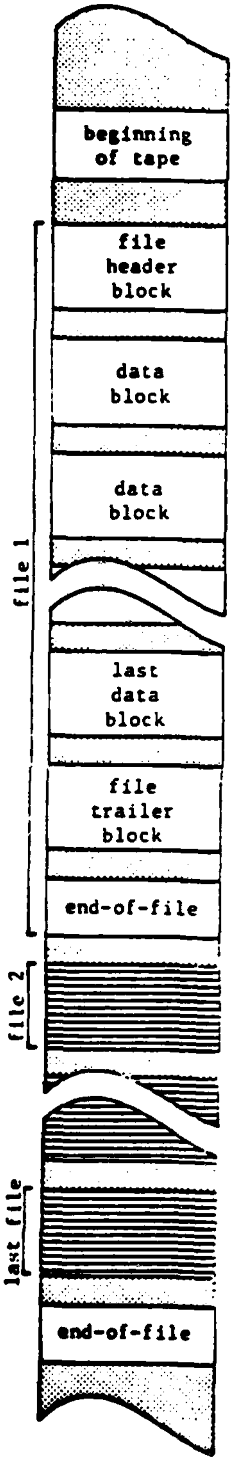
running parameters). then an end-of-file is written to the strip tape and a new strip tape is mounted following a prompt to the operator. Strip tapes are numbered sequentially beginning with 20001. The XSTPDN run is complete when all the grand intervals have been downloaded. and at that time the "last record on strip disk file" (E) in the running parameters is set to 0 as shown in Fig. 15. The format of the strip tape, and format of the blocks contained on the strip tape is given in Fig. 16.

Random Interval Download to Interval Tapes (XRANDN)

The INTRVL00 disk file, containing the 3-minute randomly spaced ambient noise samples, is downloaded to tape using program XRANDN. This program first accesses the running parameters to determine which interval tape to download to. and how many records from the INTRVL00 file to tape until the maximum number of records on tape ("B" in the running parameters) is reached. There are no end-of-files between the 3-minute intervals, however, an end-of-file is written after the last record on the interval tape. Interval tapes are numbered sequentially beginning with 30001. The XRANDN run is complete when all of the records in INTRVL00 have been downloaded, at which time item "G" in the running partameters is set to 0 as shown in Fig. 15. The format of the interval tape, and the format of the blocks contained on the interval tape is given in Fig. 17.

Checking Procedures (XSTPCHK and XINTCHK)

As a safety measure, and as a way of accumulating some preliminary statistics on the data, all strip and interval tapes are checked using programs XSTPCHK and XINTCHK. respectively. The outputs from these programs are viewed before the STRIP000 and INTRVL00 files are eliminated from disk



WHIPS Strip Tape Description

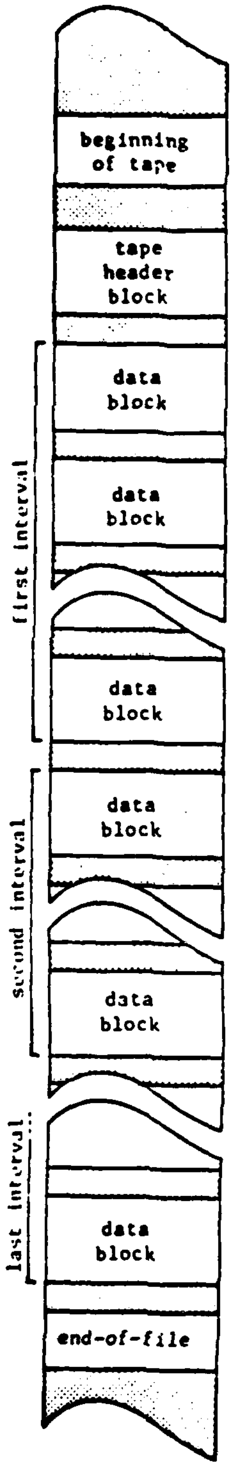
General Format: 1600 BPI
2 bytes per word
IBM format
2's complement notation

File Header Block	
Word(s)	Description
1	Always 0 to identify block as a header/trailer
2	Strip tape I.D. number
3	Strip file number
4-56	Not used
57	Estimated number of data block in this file
58-62	Not used
63	Total number of events (n) represented in this file
64-100	Not used
101-(101+n)	Event number(s)
(102+n)-end	Not used
Note: header block is the same size as the data block	

Data Block
The format of the strip tape data blocks is exactly the same as the format of the WAKEUP tape blocks.

File Trailer Block	
Word(s)	Description
1-3	Same as header block words 1-3
4-56	Not used
57	Actual number of data blocks in file
58	Number of words per block
59-63	Same as header block words 59-63
64-65	WAKEUP tape I.D. number(s)
66	Number of WAKEUP tape read errors
67-86	Block numbers with WAKEUP tape read errors
87-end	Same as header block words 87-end
Note: trailer block is the same size as the data block.	

Figure 16. Format for the WHIPS strip tapes which contain the event data.



WHIPS Interval Tape Description

General Format: 1600 BPI
2 bytes per word
IBM format
2's complement notation

Tape Header Block	
Word(s)	Description
1	Always 0 to identify block as a tape header
2	Interval tape I.D. number
3-end	Not used
Note: tape header block is the same size as the data block	

Data Block
The format of the interval tape data blocks is exactly the same as the format of the WAKEUP tape blocks.

Figure 17. Format for the WHIPS interval tapes which contain randomly spaced 3-minute intervals of data (1 per hour on the average) which are collected as noise samples.

and the WAKEUP tapes recycled. A sample output from XSTPCHK is shown in Fig. 18. Most of the lines of output are self-explanatory. The "error blocks" are for blocks of data which had tape read errors coming off of the WAKEUP tapes during XSTRIP. The "clipped data" lines show the number of data points in a particular block, and for a particular channel, which are equal to -32,768 or 32,767, the maximum and minimum values output by the A/D convertor at Wake. The clipped data in this file is on two SOFAR hydrophones and corresponds to the T-phase arrival from event 824 (see Fig. 11 for event 824). The table of values gives information about each multiplexed in the file which is described as follows: 1) "ch" - multiplexed channel number; 2) "hydr" - hydrophone number; 3) "amp" - preamp/pre-whitening filter identification number; 4) "gain" - gain step of the final stage of the preamp/pre-whitening filter (see previous section on the recording system); 5) "avgval" - the average value of this channel (non-zero due to small but constant DC biases in the amplifiers); 6) "stddev" - the standard deviation of each channel (note the much higher values for the noisier SOFAR hydrophones); 7) "0/blk" - average number of zeros per block (note that channel 3 has most zeros due to its near zero average value and small standard deviation); 8) "0/blk/std" - the standard deviation of the number of zeros per block; and 9) "# clips" - the total number of clipped data points for this channel in this file. The "worst case clock error code" indicates the maximum error between the satellite clock time written in each block header and the actual coordinated Universal Time. The codes are as follows:

0 - less than + 1 msec

1 - less than + 5 msec

```
TAPE FILE NUMBER:    8
WHIPS STRIP TAPE: 20043  WHIPS FILE:    8
NUMBER OF EVENTS IN THIS FILE:  1
EVENT NUMBER(S):  824
NUMBER OF ERRORS READING WAKEUP TAPE(S):  0
ERROR BLOCKS:
NUMBER OF MULTIPLEXED DATA CHANNELS:  8
SAMPLES PER SECOND PER CHANNEL: 80
NUMBER OF SECONDS PER BLOCK: 5.000
TIME-FIRST DATA BLOCK. 1983 03 24 (083) 10:48:00.000
RECORD: 393  CLIPPED DATA CH/#PTS:  7/  2
RECORD: 395  CLIPPED DATA CH/#PTS:  7/  5
RECORD: 396  CLIPPED DATA CH/#PTS:  7/  7
RECORD: 400  CLIPPED DATA CH/#PTS:  8/ 10
RECORD: 401  CLIPPED DATA CH/#PTS:  8/ 12
RECORD: 402  CLIPPED DATA CH/#PTS:  8/ 48
RECORD: 403  CLIPPED DATA CH/#PTS:  8/ 51
RECORD: 404  CLIPPED DATA CH/#PTS:  8/ 10
RECORD: 405  CLIPPED DATA CH/#PTS:  8/  8
TIME-LAST DATA BLOCK:  1983 03 24 (083) 11:29:55.000
RECORD  506 IS A TRAILER RECORD.
CH HYDR AMP GAIN AVGVAL STDDEV O/BLK O/BLK/STD  #CLIPS
 1  71    6    9   396.4    35.2  0.00   0.000       0
 2  73    9    9  -430.8    66.4  0.00   0.000       0
 3  74    0    9    32.2    58.8  4.38   2.202       0
 4  75   19    9   391.7    88.6  0.00   0.000       0
 5  76    1    9   109.0   238.0  1.07   1.005       0
 6  10   13    9   129.3  1363.5  0.59   0.762       0
 7  20   11    9    32.6  1388.4  1.95   1.682      14
 8  40   18    9  -189.9  2266.2  0.22   0.473     139
THE WORST CASE CLOCK ERROR CODE:  0
FILE:  8
TOTAL RECORDS IN THIS FILE (INCL. HEADER): 506
```

Figure 18. Sample output from program XSTPCHK. Detailed explanation of this figure is given in the text.

3 - less than ± 50 msec

7 - less than ± 500 msec

15 - more than ± 500 msec

A sample output from XINTCHK is shown in Fig. 19. Much less computation is done on the interval data, and the XINTCHK output serves more as a simple log of what has been saved.

Strip Tape Copies (XTAPCOP)

As a final step in the preliminary processing. the strip tapes are copied using program XTAPCOP, and the copies are sent to the DARPA Center for Seismic Studies (CSS) in Rosslyn, Virginia. Copies of interval tapes are not currently sent to CSS but may be at some time in the future.

```
RECORD     1 IS A HEADER RECORD.
#BLKS: 21     2-   22 INT: 1983 04 20 (110) 02:18:15-02:20:00 #SEC: 105.000
#BLKS: 36    23-   58 INT: 1983 04 20 (110) 03:38:00-03:41:00 #SEC: 180.000
#BLKS: 36    59-   94 INT: 1983 04 20 (110) 05:20:00-05:23:00 #SEC: 180.000
#BLKS: 36    95-  130 INT: 1983 04 20 (110) 06:47:00-06:50:00 #SEC: 180.000
#BLKS: 36   131-  166 INT: 1983 04 20 (110) 07:03:00-07:06:00 #SEC: 180.000
#BLKS: 36   167-  202 INT: 1983 04 20 (110) 08:07:00-08:10:00 #SEC: 180.000
#BLKS: 36   203-  238 INT: 1983 04 20 (110) 09:57:00-10:00:00 #SEC: 180.000
#BLKS: 36   239-  274 INT: 1983 04 20 (110) 11:18:00-11:21:00 #SEC: 180.000
#BLKS: 36   275-  310 INT: 1983 04 20 (110) 11:41:00-11:44:00 #SEC: 180.000
#BLKS: 36   311-  346 INT: 1983 04 20 (110) 12:28:00-12:31:00 #SEC: 180.000
#BLKS: 36   347-  382 INT: 1983 04 20 (110) 13:13:00-13:16:00 #SEC: 180.000
#BLKS: 36   383-  418 INT: 1983 04 20 (110) 15:03:00-15:06:00 #SEC: 180.000
#BLKS: 36   419-  454 INT: 1983 04 20 (110) 15:54:00-15:57:00 #SEC: 180.000
#BLKS: 36   455-  490 INT: 1983 04 20 (110) 16:22:00-16:25:00 #SEC: 180.000
#BLKS: 36   491-  526 INT: 1983 04 20 (110) 18:23:00-18:26:00 #SEC: 180.000
#BLKS: 36   527-  562 INT: 1983 04 20 (110) 19:30:00-19:33:00 #SEC: 180.000
#BLKS: 36   563-  598 INT: 1983 04 20 (110) 20:48:00-20:51:00 #SEC: 180.000
#BLKS: 36   599-  634 INT: 1983 04 20 (110) 21:40:00-21:43:00 #SEC: 180.000
#BLKS: 36   635-  670 INT: 1983 04 20 (110) 22:29:00-22:32:00 #SEC: 180.000
#BLKS: 36   671-  706 INT: 1983 04 20 (110) 23:10:00-23:13:00 #SEC: 180.000
#BLKS: 36   707-  742 INT: 1983 04 20 (110) 23:55:00-23:58:00 #SEC: 180.000
#BLKS: 36   743-  778 INT: 1983 04 21 (111) 01:07:00-01:10:00 #SEC: 180.000
#BLKS: 36   779-  814 INT: 1983 04 21 (111) 01:33:00-01:36:00 #SEC: 180.000
#BLKS: 36   815-  850 INT: 1983 04 21 (111) 02:26:00-02:29:00 #SEC: 180.000
#BLKS: 36   851-  886 INT: 1983 04 21 (111) 04:15:00-04:18:00 #SEC: 180.000
#BLKS: 36   887-  922 INT: 1983 04 21 (111) 05:04:00-05:07:00 #SEC: 180.000
#BLKS: 36   923-  958 INT: 1983 04 21 (111) 06:13:00-06:16:00 #SEC: 180.000
#BLKS: 36   959-  994 INT: 1983 04 21 (111) 07:27:00-07:30:00 #SEC: 180.000
#BLKS: 36   995- 1030 INT: 1983 04 21 (111) 08:13:00-08:16:00 #SEC: 180.000
#BLKS: 36 1031-1066 INT: 1983 04 21 (111) 10:04:00-10:07:00 #SEC: 180.000
#BLKS: 36 1067-1102 INT: 1983 04 21 (111) 12:04:00-12:07:00 #SEC: 180.000
#BLKS: 36 1103-1138 INT: 1983 04 21 (111) 12:22:00-12:25:00 #SEC: 180.000
#BLKS: 36 1139-1174 INT: 1983 04 21 (111) 12:27:00-12:30:00 #SEC: 180.000
#BLKS: 36 1175-1210 INT: 1983 04 21 (111) 13:15:00-13:18:00 #SEC: 180.000
#BLKS: 36 1211-1246 INT: 1983 04 21 (111) 13:48:00-13:51:00 #SEC: 180.000
#BLKS: 72 1247-1318 INT: 1983 04 21 (111) 14:47:00-14:53:00 #SEC: 360.000
#BLKS: 36 1319-1354 INT: 1983 04 21 (111) 15:19:00-15:22:00 #SEC: 180.000
#BLKS: 36 1355-1390 INT: 1983 04 21 (111) 16:41:00-16:44:00 #SEC: 180.000
#BLKS: 36 1391-1426 INT: 1983 04 21 (111) 18:07:00-18:10:00 #SEC: 180.000
#BLKS: 36 1427-1462 INT: 1983 04 21 (111) 18:53:00-18:56:00 #SEC: 180.000
#BLKS: 36 1463-1498 INT: 1983 04 21 (111) 19:27:00-19:30:00 #SEC: 180.000
#BLKS: 36 1499-1534 INT: 1983 04 21 (111) 19:38:00-19:41:00 #SEC: 180.000
#BLKS: 36 1535-1570 INT: 1983 04 21 (111) 21:02:00-21:05:00 #SEC: 180.000
#BLKS: 36 1571-1606 INT: 1983 04 21 (111) 22:03:00-22:06:00 #SEC: 180.000
#BLKS: 36 1607-1642 INT: 1983 04 21 (111) 22:18:00-22:21:00 #SEC: 180.000
#BLKS: 36 1643-1678 INT: 1983 04 22 (112) 00:08:00-00:11:00 #SEC: 180.000
#BLKS: 36 1679-1714 INT: 1983 04 22 (112) 00:18:00-00:21:00 #SEC: 180.000
```

Figure 19. Sample output from program XINTCHK showing some of the 3-minute intervals saved on a WHIPS interval tape. The first interval shown, blocks 2-22, contains only 105 seconds because part of that interval was written to the previous interval tape. Another interval, blocks 1247-1318, contains 360 seconds and represents two contiguous 3-minute intervals.

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APPENDIX X

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 5 JUL 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT *NO*	YR	MO	DA	JUL	ORIGIN TIME HR*MN*SECS	COORDINATES LAT	LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	SRF	INF SRC	EV TP	SAVED PHASES	INTERVAL	MNS	STRIP TAPE/FILE
0001	82	09	09	252	03:06:44.0	30.299N	137.670E	SOUTH OF HONSHU, JAPAN	481	5.0	0.0	PDE	EQ	ABDE	03:08-03:50	43	20001/ 06
0002	82	09	09	252	05:43:52.1	3.306S	177.566E	GILBERT ISLANDS REGION	33	5.4	0.0	PDE	EQ	ABDE	05:44-06:22	39	20001/ 07
0003	82	09	09	252	06:40:21.2	35.597S	102.453W	SOUTHERN PACIFIC OCEAN.	10	5.1	0.0	PDE	EQ	A	06:49-07:09	21	20001/ 08
0004	82	09	09	252	12:49:08.4	43.563N	146.606E	KURIL ISLANDS	33	4.7	0.0	PDE	EQ	ABD	12:50-13:17	28	20001/ 09
0005	82	09	09	252	15:42:22.0	15.493N	147.571E	MARIANA ISLANDS REGION	33	5.4	5.2	PDE	EQ	ABDE	15:41-16:12	32	20001/ 10
0006	82	09	09	252	16:09:30.3	15.518N	147.593E	MARIANA ISLANDS REGION	33	5.2	0.0	PDE	EQ	ABDE	16:09-16:39	31	20001/ 10
0007	82	09	09	252	16:13:59.7	15.638N	147.648E	MARIANA ISLANDS	33	5.1	0.0	PDE	EQ	ABDE	16:13-16:44	32	20001/ 10
0008	82	09	09	252	16:40:13.1	22.103S	169.446E	LOYALTY ISLANDS	33	5.5	4.9	PDE	EQ	A	16:43-16:54	12	20001/ 10
0009	82	09	10	253	01:43:15.2	3.437S	177.650E	GILBERT ISLANDS	33	5.1	0.0	PDE	EQ	ABDE	01:43-02:22	40	20001/ 11
0010	82	09	10	253	10:20:37.5	55.161N	161.673E	NEAR EAST COAST OF KAMCHATKA	33	5.0	4.3	PDE	EQ	ABDE	10:23-11:13	51	20002/ 01
0011	82	09	10	253	13:41:42.2	2.447N	126.910E	MOLUCCA PASSAGE 46 DEGS.	45	4.8	0.0	PDE	EQ	A	13:45-13:56	12	20002/ 02
0012	82	09	11	254	06:31:48.6	26.620S	176.644W	SOUTH OF FIJI ISLANDS 49 DEGS.	33	5.2	4.9	PDE	EQ	A	06:41-07:00	20	20002/ 03
0013	82	09	11	254	06:57:44.6	26.883S	176.218W	SOUTH OF FIJI ISLANDS 49 DEGS.	33	5.0	4.9	PDE	EQ	A	07:01-07:13	13	20002/ 03
0014	82	09	11	254	13:59:07.0	15.611N	147.818E	MARIANA ISLANDS	38	4.2	0.0	PDE	EQ	ABD	13:58-14:27	30	20002/ 04
0015	82	09	12	255	03:42:43.1	42.031N	142.702E	HOKKAIDO, JAPAN	66	4.8	0.0	PDE	EQ	ABD	03:44-03:59	16	20002/ 05
0016	82	09	12	255	07:22:39.3	19.727S	177.914W	FIJI ISLANDS	577	5.1	0.0	PDE	EQ	A	07:25-07:37	13	20002/ 06
0017	82	09	12	255	08:46:06.0	26.952S	176.475W	SOUTH OF FIJI	33	5.1	5.2	PDE	EQ	A	08:50-09:01	12	20002/ 07
0018	82	09	12	255	09:22:23.2	52.671N	166.937W	FOX ISLANDS, ALEUTIAN ISLANDS.	33	5.7	5.8	PDE	EQ	ABDE	09:26-10:18	53	20002/ 08
0019	82	09	12	255	11:59:52.6	52.783N	166.772W	FOX ISLANDS, ALEUTIAN ISLANDS.	33	5.2	4.9	PDE	EQ	ABDE	12:03-12:56	54	20002/ 09
0020	82	09	12	255	13:03:10.2	0.820N	126.037E	MOLLACA PASSAGE	70	4.9	0.0	PDE	EQ	A	13:12-13:31	20	20002/ 10
0021	82	09	12	255	16:50:38.0	52.847N	166.977W	FOX ISLANDS, ALEUTIAN ISLANDS.	33	5.5	5.1	PDE	EQ	ABDE	16:53-17:46	54	20002/ 11
0022	82	09	13	256	16:46:57.7	17.992S	178.496W	FIJI ISLANDS.	597	4.3	0.0	PDE	EQ	A	16:49-17:01	13	20003/ 02
0023	82	09	13	256	18:03:36.3	37.526N	141.306E	NEAR COAST OF HONSHU, JAPAN.	62	5.0	0.0	PDE	EQ	ABDE	18:04-18:47	44	20003/ 03
0024	82	09	13	256	19:08:51.6	3.528S	177.622E	GILBERT ISLANDS.	33	5.2	5.1	PDE	EQ	ABDE	19:09-19:47	39	20003/ 04
0025	82	09	14	257	00:26:04.9	15.495N	147.722E	MARIANA ISLANDS.	38	4.8	0.0	PDE	EQ	ABD	00:25-00:38	14	20003/ 05
0026	82	09	14	257	03:53:42.6	3.442S	177.667E	GILBERT ISLANDS.	33	5.4	0.0	PDE	EQ	ABDE	03:54-04:32	39	20003/ 06
0027	82	09	14	257	05:11:49.4	31.077S	179.615W	KERMADEC ISLANDS.	78	5.4	0.0	PDE	EQ	A	05:21-05:40	20	20003/ 07
0028	82	09	14	257	11:37:18.6	43.729N	140.130E	HOKKAIDO, JAPAN.	161	5.2	0.0	PDE	EQ	ABDE	11:39-12:26	48	20003/ 08
0029	82	09	14	257	12:42:23.8	27.017S	176.480W	KERMADEC ISLANDS.	33	5.0	4.6	PDE	EQ	A	12:46-12:57	12	20003/ 09
0030	82	09	14	257	18:17:02.4	7.247S	149.056E	EAST PAPUA NEW GUINEA.	33	5.0	6.3	PDE	EQ	ABDE	18:18-19:04	47	20003/ 10
0031	82	09	14	257	21:18:38.5	7.368S	13.499W	ASCENSION ISLAND.	10	4.9	0.0	PDE	EQ	A	21:28-21:47	20	20003/ 11
0032	82	09	15	258	20:22:57.5	14.515S	70.842W	PERU. MB 6.3 (BRK).	152	5.9	0.0	PDE	EQ	A	20:32-20:51	20	20004/ 01
0033	82	09	15	258	22:34:09.2	21.510S	169.308E	LOYALTY ISLANDS.	67	5.6	0.0	PDE	EQ	A	22:37-22:48	12	20004/ 02
0034	82	09	15	258	23:31:54.1	12.022N	143.743E	SOUTH OF MARIANA ISLANDS	33	4.9	0.0	PDE	EQ	ABD	23:32-00:00	29	20004/ 03
0035	82	09	16	259	02:20:38.5	30.183N	138.966E	SOUTH OF HONSHU, JAPAN.	378	5.1	0.0	PDE	EQ	ABDE	02:21-03:02	42	20004/ 04
0036	82	09	16	259	03:07:58.5	3.568S	177.684E	GILBERT ISLANDS.	33	4.8	0.0	PDE	EQ	ABD	03:08-03:22	15	20004/ 05
0037	82	09	16	259	08:23:23.2	15.335S	173.283W	TONGA ISLANDS.	129	5.5	0.0	PDE	EQ	A	08:26-08:37	12	20004/ 06
0038	82	09	16	259	09:21:11.0	5.261S	152.059E	NEW BRITAIN.	63	5.2	0.0	PDE	EQ	ABDE	09:22-10:03	42	20004/ 07
0039	82	09	16	259	11:41:00.9	3.351S	177.602E	GILBERT ISLANDS.	33	5.2	4.7	PDE	EQ	ABDE	11:41-12:19	39	20004/ 08
0040	82	09	16	259	12:27:38.7	7.294S	127.056E	BANDA SEA.	309	5.0	0.0	PDE	EQ	A	12:31-12:42	12	20004/ 09
0041	82	09	16	259	13:28:39.3	6.070N	125.882E	MINDANAO, PHILIPPINE ISLANDS.	169	5.1	0.0	PDE	EQ	A	13:31-13:43	13	20004/ 10
0042	82	09	16	259	16:46:02.2	3.397S	177.557E	GILBERT ISLANDS.	33	4.7	0.0	PDE	EQ	ABD	16:46-17:14	29	20004/ 11
0043	82	09	08	251	06:07:53.3	41.411N	160.095E	DOWNHOLE NEAR KURIL IS.	0	0.0	0.0	OTH	SX	AE	06:08-06:44	37	0/ 00
0044	82	09	08	251	09:00:35.8	41.715N	160.077E	DOWNHOLE NEAR KURIL IS.	0	0.0	0.0	OTH	SX	AE	09:01-09:37	37	0/ 00
0045	82	09	08	251	12:00:24.7	42.017N	160.033E	DOWNHOLE NEAR KURIL IS.	0	0.0	0.0	OTH	SX	AE	12:00-12:37	38	20001/ 01
0046	82	09	08	251	15:01:23.3	42.317N	160.010E	DOWNHOLE NEAR KURIL IS.	0	0.0	0.0	OTH	SX	AE	15:01-15:38	38	20001/ 02
0047	82	09	08	251	18:01:00.5	42.605N	159.971E	DOWNHOLE NEAR KURIL IS.	0	0.0	0.0	OTH	SX	AE	18:01-18:38	38	20001/ 03
0048	82	09	08	251	21:00:23.5	42.883N	159.906E	DOWNHOLE NEAR KURIL IS.	0	0.0	0.0	OTH	SX	AE	21:00-21:38	39	20001/ 04
0049	82	09	09	252	00:00:57.9	43.203N	159.793E	DOWNHOLE NEAR KURIL IS.	0	0.0	0.0	OTH	SX	AE	00:01-00:39	39	20001/ 05
0050	82	09	12	255	22:45:04.2	44.252N	160.776E	KURILS DOWNHOLE - 240# SHOT	0	0.0	0.0	OTH	SX	AE	22:45-23:24	40	20002/ 12
0051	82	09	12	255	23:01:00.5	44.276N	160.826E	KURILS DOWNHOLE - 240# SHOT	0	0.0	0.0	OTH	SX	AE	23:01-23:40	40	20003/ 01
0052	82	09	12	255	23:16:58.8	44.296N	160.881E	KURILS DOWNHOLE - 240# SHOT	0	0.0	0.0	OTH	SX	AE	23:17-23:56	40	20003/ 01
0053	82	09	12	255	23:33:02.3	44.316N	160.935E	KURILS DOWNHOLE - 240# SHOT	0	0.0	0.0	OTH	SX	AE	23:33-00:12	40	20003/ 01
0054	82	09	12	255	23:49:05.4	44.338N	160.982E	KURILS DOWNHOLE - 240# SHOT	0	0.0	0.0	OTH	SX	AE	23:49-00:28	40	20003/ 01
0055	82	09	13	256	00:05:07.1	44.359N	161.037E	KURILS DOWNHOLE - 240# SHOT	0	0.0	0.0	OTH	SX	AE	00:05-00:44	40	20003/ 01
0056	82	09	17	260	02:57:48.1	11.151S	162.212E	SOLOMON ISLANDS	69	5.2	0.0	PDE	EQ	ABDE	02:59-03:43	45	20005/ 01
0057	82	09	17	260	04:15:21.7	17.725S	172.756W	TONGA IS. REG.	33	5.2	5.4	PDE	EQ	A	04:24-04:44	21	20005/ 02
0058	82	09	17	260	09:40:41.2	3.400S	177.608E	GILBERT IS. REG.	33	4.7	0.0	PDE	EQ	ABD	09:41-10:09	29	20005/ 03
0059	82	09	17	260	13:28:25.6	23.446S	179.947W	S. OF FIJI IS.	555	5.9	0.0	PDE	EQ	A	13:37-13:57	21	20005/ 04
0060	82	09	17	260	15:38:16.6	11.857S	117.108E	S. OF SUMBAWA IS.	33	5.1	0.0	PDE	EQ	A	15:43-15:54	12	20005/ 05
0061	82	09	17	260	20:21:03.1	23.426S	179.611W	S. OF FIJI IS.	33	5.3	0.0	PDE	EQ	A	20:24-20:35	12	20005/ 06
0062	82	09	18	261	14:25:03.8	3.488S	177.679E	GILBERT IS. REG.	33	5.0	0.0	PDE	EQ	ABDE	14:25-15:04	40	20005/ 07
0063	82	09	18	261	15:00:41.3	7.676S	127.477E	BANDA SEA	165	5.4	0.0	PDE	EQ	A	15:04-15:15	12	20008/ 06
0064	82	09	18	261	18:19:35.9	36.118N	141.454E	NR. E. COAST HONSHU, JAPAN	33	4.7	0.0	PDE	EQ	ABD	18:21-18:48	28	20005/ 09
0065	82	09	18	261	21:20:19.2	26.950S	176.461W	S. OF. FIJI IS.	116	5.2	0.0	PDE	EQ	A	21:24-21:35	12	20008/ 07
0066	82	09	20	263	12:57:45.3	26.924S	175.814W	S. OF TONGA IS.	33	5.5	6.0	PDE	EQ	ABDE	13:01-14:06	66	20005/ 11
0067	82	09	20	263	13:48:32.5	26.870S	175.934W	S. OF TONGA IS.	33	5.1	0.0	PDE	EQ	A	13:52-14:04	13	20005/ 11
0068	82	09	20	263	13:56:06.6	54.612S	143.723E	W. OF MACQUARIE IS.	10	5.7	5.8	PDE	EQ	A	14:05-14:24	20	20005/ 11
0069	82	09	20	263	17:05:06.3	26.858S	176.406W	S. OF FIJI IS.	67	5.3	0.0	PDE	EQ	A	17:09-17:20	12	20005/ 12
0070	82	09	20	263	19:30:28.6	27.116S	176.633W	KERMADEC IS. REG.	33	5.0	0.0	PDE	EQ	A	19:34-19:45	12	20005/ 13
0071	82	09	21	264	00:46:31.7	9.581S	151.972E	DENTRECASTEAUX IS. REG.	33	5.6	5.9	PDE	EQ	A	00:48-00:59	12	20005/ 14
0072	82	09	21	264	01:28:19.6	9.584S	152.252E	DENTRECASTEAUX IS. REG.	33	5.8	6.1	PDE	EQ	A	01:30-01:41	12	20005/ 15
0073	82	09	21	264	02:02:31.7	9.331S	152.320E	DENTRECASTEAUX IS. REG.	33	5.5	0.0	PDE	EQ	A	02:04-02:15	12	20005/ 16
0074	82	09	21	264	02:57:01.1	49.909N	78.229E	EASTERN KAZAKH SSR	0	5.2	0.0	PDE	NX	A	03:04-03:15	12	20008/ 08
0075	82	09	21	264	17:54:00.4	4.461S	126.569E	BANDA SEA	33	5.0	0.0	PDE	EQ	A	17:57-18:08	12	20005/ 18
0076	82	09	22	265	04:12:31.6	3.681S	177.756E	GILBERT IS. REG.	33	4.7	0.0	PDE	EQ	ABD	04:13-04:27	15	20005/ 19
0077	82	09	22	265	08:17:32.3	33.512N	143.144E	OFF E. COAST OF HONSHU	33	4.4	0.0	PDE	EQ	ABD	08:18-08:32	15	20005/ 20
0078	82	09	22	265	10:39:13.3	42.193N	142.559E	HOKKAIDO, JAPAN REG.	33	4.8	0.0	PDE	EQ	ABD	10:40-10:56	17	20006/ 01
0079	82	09	22	265	12:01:26.9	36.300N	71.310E	AFGHANISTAN-USSR BORDER REGION	185	4.7	0.0	PDE	EQ	A	12:08-12:20	13	20006/ 02
0080	82	09	22	265	21:25:51.9	26.864S	176.145W	SOUTH OF FIJI IS.	33	5.2	0.0	PDE	EQ	A	21:29-21:41	13	20006/ 03
0081	82	09	23	266	04:20:06.7	21.701N	143.008E	MARIANA ISLANDS REGION.	321	5.0	0.0	PDE	EQ	ABDE	04:20-04:55	36	20006/ 04
0082	82	09	23	266	16:00:00.0	37.212N	116.207W	SOUTHERN NEVADA.	0	4.9	0.0	PDE	NX	A	16:06-16:17	12	20006/ 05
0083	82	09	23	266	17:00:00.0	37.175N	116.088W	SOUTHERN NEVADA.	0	4.9	0.0	PDE	NX	A	17:06-17:17	12	23006/ 06
0084	82	09	24	267	07:40:24.3	37.852N	118.123W	CALIFORNIA-NEVADA BORDERREG.	5	5.0	4.6	PDE	EQ	A	07:46-07:57	12	20006/ 07
0085	82	09	24	267	18:57:55.5	15.737N	147.583E	MARIANA IS. REGION.	49	5.1	4.3	PDE	EQ	ABDE	18:57-19:28	32	20006/ 08
0086	82	09	24	267	19:47:18.0	0.268N	120.753E	MINAHASSA PENINSULA.	123	5.5	0.0	PDE	EQ	A	19:51-20:02	12	20006/ 09
0087	82	09	24	267	21:11:27.9	3.367S	177.604E	GILBERT IS. REGION.	28	5.1	0.0	PDE	EQ	ABDE	21:12-21:50	39	20006/ 10
0088	82	09	24	267	22:34:47.8	6.002N	126.711E	MINDANAO, PHILIPPINE IS.	50	5.0	5.3	PDE	EQ	A	22:37-22:49	13	20006/ 11
0089	82	09	24	267	22:51:50.9	5.980N	126.671E	MINDANAO, PHILIPPINE IS.	35	5.5	5.6	PDE	EQ	A	22:54-23:06	13	20006/ 12
0090	82	09	25	268	03:11:41.4	4.426S	102.132E	SOUTHERN SUMATERA	51	5.1	0.0	PDE	EQ	A	03:18-03:29	12	20006/ 13
0091	82	09	25	268	08:48:43.6	15.736N	147.606E	MARIANA IS. REGION.	55	5.2	0.0	PDE	EQ	ABDE	08:48-09:18	31	20006/ 14
0092	82	09	25	268	09:03:43.5	17.557S	179.075W	FIJI IS.	543	5.0	0.0	PDE	EQ	A	09:05-09:17	13	20006/ 14
0093	82	09	25	268	16:04:01.8	11.361S	166.287E	SANTA CRUZ ISL.	47	5.5	5.3	PDE	EQ	A	16:05-16:16	12	20006/ 15
0094	82	09	25	268	17:59:57.0	64.311N	91.859E	CENTRAL SIBERIA.	0	5.1	0.0	PDE	NX	A	18:06-18:17	12	20006/ 16
0095	82	09	25	268	18:08:36.8	7.098S	129.795E	BANDA SEA.	94	5.5	0.0	PDE	EQ	A	18:11-18:22	12	20006/ 16
0096	82	09	26	269	01:09:28.4	50.040N	158.888E	KURIL IS. REGION.	42	5.5	4.5	PDE	EQ	ABDE	01:11-01:56	46	20006/ 17
0097	82	09	26	269	04:46:37.9	47.033N	152.370E	KURIL IS.	112	5.6	0.0	PDE	EQ	ABDE	04:47-05:32	46	20006/ 18
0098	82	09	26	269	08:32:31.7	6.619N	126.772E	MINDANAO, PHILIPPINE IS.	192	5.4	0.0	PDE	EQ	A	08:35-08:46	12	20006/ 19
0099	82	09	26	269	14:00:49.8	3.392S	177.612E	GILBERT IS. REGION.	25	5.4	4.9	PDE	EQ	ABDE	14:01-14:39	39	20006/ 20
0100	82	09	27	270	08:55:33.5	1.263N	126.325E	MOLUCCA PASSAGE.	56	5.5	0.0	PDE	EQ	A	08:58-09:10	13	20006/ 21

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 5 JUL 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT NO	YR	MO	DA	JUL	ORIGIN TIME HR:MN:SECS	LAT	LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	MAGNI SRF	INF SRC	EV TP	PHASES	SAVED INTERVAL	MNS	STRIP TAPE/FILE
0101	82	09	27	270	12:37:38.4	39.270N	73.704E	TAJIK-SINKIANG BORDER REGION.	33	4.8	4.0	PDE	EQ	A	12:45-12:56	12	20027/01
0102	82	09	27	270	21:37:12.7	10.327N	126.158E	PHILIPPINE IS. REGION.	54	5.0	0.0	PDE	EQ	A	21:40-21:51	12	20027/02
0103	82	09	28	271	05:07:15.7	3.029S	177.554E	GILBERT IS. REGION.	33	4.9	0.0	PDE	EQ	ABD	05:07-05:21	15	20027/03
0104	82	09	28	271	15:14:36.0	24.173S	176.754W	SOUTH OF FIJI IS.	40	6.0	6.1	PDE	EQ	AE	15:18-16:19	62	20027/04
0105	82	09	28	271	22:42:20.6	15.685N	147.658E	MARIANA IS. REGION.	33	5.1	0.0	PDE	EQ	ABDE	22:41-23:12	32	20027/05
0106	82	09	28	271	22:48:05.4	15.720N	147.761E	MARIANA IS. REGION.	33	4.7	0.0	PDE	EQ	ABD	22:47-23:00	14	20027/05
0107	82	09	29	272	04:24:16.1	37.346N	72.942E	TAJIK SSR	33	5.4	4.9	PDE	EQ	A	04:31-04:43	13	20027/06
0108	82	09	29	272	05:53:33.5	37.297N	73.258E	TAJIK SSR	33	4.8	0.0	PDE	EQ	A	06:01-06:12	12	20027/07
0109	82	09	29	272	09:29:47.2	25.139N	141.751E	VOLCANO ISLANDS REGION.	103	4.9	0.0	PDE	EQ	ABD	09:30-09:44	15	20027/08
0110	82	09	29	272	13:30:00.1	37.091N	116.045W	SOUTHERN NEVADA	0	0.0	0.0	PDE	NX	A	13:36-13:47	12	20027/09
0111	82	09	29	272	19:03:37.3	7.269S	155.723E	SOLOMON IS.	55	5.0	4.5	PDE	EQ	ABDE	19:04-19:46	43	20027/10
0112	82	09	29	272	20:46:49.9	7.275S	155.894E	SOLOMON IS.	33	5.1	4.4	PDE	EQ	ABDE	20:48-21:29	42	20027/11
0113	82	09	30	273	01:44:06.0	6.981S	155.750E	SOLOMON IS.	42	5.0	0.0	PDE	EQ	ABDE	01:45-02:26	42	20027/12
0114	82	09	30	273	02:28:30.0	21.528S	177.900W	FIJI IS. REG.	400	4.4	0.0	PDE	EQ	A	02:31-02:42	12	20027/13
0115	82	09	30	273	05:44:49.1	30.051N	73.996E	TAJIK-SINKIANG BORDER REGION.	184	4.8	0.0	PDE	EQ	A	05:52-06:03	12	20027/14
0116	82	09	30	273	14:23:58.5	14.658S	173.204W	SAMOA IS. REGION.	20	5.6	5.5	PDE	EQ	A	14:26-14:38	13	20027/15
0117	82	10	01	274	16:53:51.6	37.790N	139.476E	HONSHU, JAPAN	150	5.1	0.0	PDE	EQ	ABDE	16:55-17:39	45	20027/16
0118	82	10	02	275	00:29:13.0	27.720N	139.852E	BONIN ISLANDS REGION	485	4.2	0.0	PDE	EQ	ABD	00:29-00:44	16	20027/17
0119	82	10	02	275	04:54:07.5	8.883S	118.827E	SUMBAWA ISLAND REGION	33	4.9	0.0	PDE	EQ	A	04:59-05:10	12	20027/18
0120	82	10	02	275	08:26:25.5	14.738S	167.284E	VANUATU ISLANDS	152	5.5	0.0	PDE	EQ	A	08:29-08:39	12	20027/19
0121	82	10	03	276	01:12:58.0	5.646S	129.899E	BANDA SEA	220	5.0	0.0	PDE	EQ	A	01:16-01:27	12	20027/20
0122	82	10	03	276	08:41:29.4	3.372S	177.553E	GILBERT ISLANDS REGION	33	5.0	4.7	PDE	EQ	ABDE	08:42-09:20	39	20028/01
0123	82	10	03	276	11:02:04.3	9.377S	152.347E	DENTRECASTEAUX ISLANDS REGION	39	5.1	0.0	PDE	EQ	A	11:03-11:15	13	20028/09
0124	82	10	03	276	16:10:09.3	55.963N	149.967W	GULF OF ALASKA	33	4.2	0.0	PDE	EQ	A	16:22-16:33	12	20028/02
0125	82	10	03	276	19:59:34.8	6.468S	152.038E	NEW BRITAIN REGION	42	5.2	0.0	PDE	EQ	ABDE	20:01-20:44	44	20028/03
0126	82	10	03	276	22:26:34.0	0.142S	118.407E	SUMBAWA ISLAND REGION	33	4.7	0.0	PDE	EQ	A	22:31-22:42	12	20028/04
0127	82	10	03	276	23:29:31.2	42.064N	140.761E	HOKKAIDO, JAPAN REGION.	152	4.7	0.0	PDE	EQ	ABD	23:31-23:47	17	20028/05
0128	82	10	04	277	07:46:53.2	51.771N	176.009W	ANDREANOF ISL., ALEUTION ISL.	62	5.4	0.0	PDE	EQ	ABDE	07:49-08:37	49	20028/10
0129	82	10	04	277	08:52:28.4	5.842N	126.744E	MINDANAO, PHILIPPINE ISL.	94	5.4	0.0	PDE	EQ	A	08:55-09:06	12	20028/11
0130	82	10	04	277	15:23:26.9	22.664S	171.192E	LOYALTY ISLAND REGION	33	5.1	5.0	PDE	EQ	A	15:26-15:37	12	20028/12
0131	82	10	04	277	16:20:40.0	22.605S	171.153E	LOYALTY ISLAND REGION	33	4.9	0.0	PDE	EQ	A	16:23-16:35	13	20028/13
0132	82	10	05	278	03:18:53.0	0.217N	122.244E	MINAHASSA PENINSULA	221	4.8	0.0	PDE	EQ	A	03:22-03:33	12	20028/14
0133	82	10	05	278	04:09:16.7	3.410S	177.591E	GILBERT ISL. REGION	33	5.3	0.0	PDE	EQ	ABDE	04:09-04:48	40	20028/15
0134	82	10	05	278	09:14:41.3	15.642S	167.930E	VANUATU ISL	91	5.9	0.0	PDE	EQ	ABDE	09:16-10:05	50	20028/16
0135	82	10	05	278	10:15:15.4	30.229S	178.056W	KERMADEC ISL	146	5.5	0.0	PDE	EQ	A	10:19-10:30	12	20028/17
0136	82	10	05	278	12:04:13.2	4.239N	126.657E	TALAUD ISLANDS	95	5.3	0.0	PDE	EQ	A	12:07-12:18	12	20028/18
0137	82	10	05	278	19:46:27.6	33.149N	136.900E	NEAR S. COAST OF SOUTH HONSHU	391	4.7	0.0	PDE	EQ	ABD	19:47-20:03	17	20028/19
0138	82	10	05	278	22:17:19.9	30.161S	179.304W	KERMADEC ISL. REGION	325	4.9	0.0	PDE	EQ	A	20:21-20:32	12	20028/20
0139	82	10	05	278	22:25:56.0	22.817S	171.187E	LOYALTY ISL. REGION	45	5.6	5.4	PDE	EQ	A	20:29-20:40	12	20028/20
0140	82	10	06	279	21:13:12.0	22.880S	171.241E	LOYALTY IS. REGION	33	5.5	5.1	PDE	EQ	A	21:16-21:27	12	20028/21
0141	82	10	07	280	01:52:29.3	23.376N	94.349E	BURMA-INDIA BORDER REGION	98	4.7	0.0	PDE	EQ	A	01:58-02:09	12	20028/22
0142	82	10	07	280	07:15:56.9	7.163S	125.910E	BANDA SEA	518	6.2	0.0	PDE	EQ	A	07:19-07:31	13	20029/01
0143	82	10	07	280	09:26:01.4	3.496S	177.516E	GILBERT IS. REGION	26	4.7	0.0	PDE	EQ	ABD	09:26-09:40	15	20029/02
0144	82	10	07	280	11:02:17.4	32.340N	137.455E	SOUTH OF HONSHU, JAPAN.	388	5.1	0.0	PDE	EQ	ABDE	11:03-11:46	44	20029/03
0145	82	10	07	280	13:40:19.2	3.546S	177.679E	GILBERT IS. REGION	29	4.9	4.4	PDE	EQ	ABD	13:40-13:55	16	20029/04
0146	82	10	07	280	21:57:03.3	32.143N	142.301E	SOUTH OF HONSHU, JAPAN.	33	4.8	0.0	PDE	EQ	ABD	21:57-22:12	16	20029/05
0147	82	10	08	281	13:34:57.2	26.356N	99.849E	YUNNAN PROVINCE, CHINA	40	5.0	4.5	PDE	EQ	A	13:40-13:51	12	20029/06
0148	82	10	08	281	18:45:39.4	23.314S	179.850E	SOUTH OF FIJI IS.	650	5.1	0.0	PDE	EQ	A	18:48-18:59	12	20029/07
0149	82	10	08	281	18:59:11.0	37.504N	72.095E	TAJIK SSR	33	5.2	0.0	PDE	EQ	A	19:06-19:18	12	20029/08
0150	82	10	09	282	00:53:15.2	40.147N	143.742E	OFF EAST COAST OF HONSHU, JAPA	33	4.8	4.5	PDE	EQ	ABD	00:54-01:09	16	20029/09
0151	82	10	09	282	18:53:02.1	3.519S	177.788E	GILBERT IS. REGION	33	5.3	4.7	PDE	EQ	ABDE	18:53-19:32	40	20029/10
0152	82	10	09	282	19:40:23.0	3.478S	177.675E	GILBERT IS. REGION	33	5.3	4.4	PDE	EQ	ABDE	19:41-20:19	39	20029/11
0153	82	10	09	282	22:09:11.7	16.565S	167.479E	VANUATU IS.	33	5.1	4.7	PDE	EQ	A	22:11-22:22	12	20029/12
0154	82	10	10	283	04:59:56.0	61.555N	112.833E	CENTRAL SIBERIA	0	5.3	0.0	PDE	NX	A	05:05-05:16	12	20029/13
0155	82	10	10	283	12:41:00.2	17.762S	178.573W	FIJI IS. REGION	596	4.1	0.0	PDE	EQ	A	12:43-12:54	12	20029/14
0156	82	10	10	283	17:23:03.0	40.171N	143.882E	OFF EAST COAST OF HONSHU, JAPA	28	5.4	5.2	PDE	EQ	ABDE	17:24-18:06	43	20029/15
0157	82	10	10	283	20:36:28.6	7.222S	129.621E	BANDA SEA	149	4.8	0.0	PDE	EQ	A	20:39-20:51	13	20029/16
0158	82	10	11	284	07:14:58.1	73.368N	54.532E	NOVAYA ZEMLYA	0	5.6	3.6	PDE	NX	A	07:22-07:33	12	20029/17
0159	82	10	11	284	10:25:35.2	62.551S	166.866E	BALENNY IS. REGION	10	5.8	4.9	PDE	EQ	A	10:33-10:44	12	20029/18
0160	82	10	11	284	16:34:47.0	27.439S	176.441W	KERMADEC IS. REGION	45	5.2	0.0	PDE	EQ	A	16:38-16:50	13	20029/19
0161	82	10	12	285	04:49:38.9	37.280N	69.704E	AFGHANISTAN-USSR BORDER REGION	33	4.8	0.0	PDE	EQ	A	04:57-05:08	12	20029/20
0162	82	10	12	285	08:39:57.3	21.186S	175.637W	TONGA IS.	198	4.7	0.0	PDE	EQ	A	08:43-08:54	12	20029/21
0163	82	10	13	286	18:52:49.3	14.156N	124.467E	LUZON, PHILIPPINE IS.	33	5.1	0.0	PDE	EQ	A	18:55-19:07	13	20029/22
0164	82	10	14	287	21:40:19.5	27.485N	139.837E	BONIN IS. REGION	495	5.1	0.0	PDE	EQ	ABDE	21:40-22:20	41	20029/23
0165	82	10	14	287	21:59:44.4	38.449N	133.581E	SEA OF JAPAN	416	4.3	0.0	PDE	EQ	ABD	22:01-22:18	18	20029/23
0166	82	10	15	288	00:54:09.9	5.049N	126.242E	MINDANAO, PHILIPPINE IS.	94	5.3	0.0	PDE	EQ	A	00:57-01:08	12	20030/01
0167	82	10	15	288	10:58:39.0	32.871N	125.756W	NORTH PACIFIC OCEAN.	10	5.1	4.4	PDE	EQ	A	11:04-11:15	12	20030/02
0168	82	10	16	289	01:53:30.9	5.544S	146.247E	EAST PAPUA NEW GUINEA REGION	76	5.3	0.0	PDE	EQ	ABDE	01:55-02:40	46	20030/03
0169	82	10	16	289	03:02:58.3	34.681N	139.411E	NEAR S. COAST OF HONSHU, JAPAN	133	4.7	0.0	PDE	EQ	ABD	03:04-03:19	16	20030/04
0170	82	10	16	289	05:59:57.2	46.727N	48.162E	SOUTHWESTERN USSR	0	5.2	3.0	PDE	NX	A	06:08-06:19	12	20030/05
0171	82	10	16	289	06:04:57.1	46.723N	48.222E	SOUTHWESTERN USSR	0	5.3	3.0	PDE	NX	A	06:13-06:24	12	20030/05
0172	82	10	16	289	06:09:57.1	46.748N	48.258E	SOUTHWESTERN USSR	0	5.2	3.1	PDE	NX	A	06:18-06:29	12	20030/05
0173	82	10	16	289	06:14:57.1	46.707N	48.230E	SOUTHWESTERN USSR	0	5.4	3.1	PDE	NX	A	06:23-06:34	12	20030/05
0174	82	10	16	289	08:02:54.3	23.321S	171.684E	LOYALTY IS. REGION	33	5.0	4.2	PDE	EQ	A	08:06-08:17	12	20030/06
0175	82	10	16	289	08:46:56.0	36.486N	71.228E	AFGHANISTAN-USSR BORDER REGION	230	4.6	0.0	PDE	EQ	A	08:54-09:05	12	20030/07
0176	82	10	17	290	10:12:09.0	49.620N	155.919E	KURIL IS.	47	5.5	4.9	PDE	EQ	ABDE	10:13-10:59	47	20030/08
0177	82	10	18	291	12:12:50.0	12.826N	143.427E	SOUTH OF MARIANA IS.	110	5.0	0.0	PDE	EQ	ABDE	12:13-12:48	36	20030/09
0178	82	10	19	292	03:34:36.2	17.804S	173.233W	TONGA IS.	90	5.4	0.0	PDE	EQ	A	03:37-03:48	12	20030/10
0179	82	10	19	292	03:43:05.9	15.565S	174.985W	TONGA IS.	202	5.2	0.0	PDE	EQ	A	03:45-03:56	12	20030/10
0180	82	10	19	292	12:46:03.0	39.931N	118.882E	NORTHEASTERN CHINA.	33	5.0	0.0	PDE	EQ	A	12:49-13:01	13	20030/11
0181	82	10	19	292	16:19:05.5	11.394S	163.149E	SOLOMON IS.	46	5.6	5.9	PDE	EQ	ABDE	16:20-17:05	46	20030/12
0182	82	10	19	292	22:28:09.6	3.114S	129.846E	CERAM	33	5.1	0.0	PDE	EQ	A	22:31-22:42	12	20030/13
0183	82	10	20	293	02:29:49.7	9.112N	125.882E	MINDANAO, PHILIPPINE IS.	144	4.9	0.0	PDE	EQ	A	02:32-02:43	12	20030/14
0184	82	10	20	293	05:36:06.2	41.158N	142.941E	HOKKAIDO, JAPAN REGION	33	5.1	4.7	PDE	EQ	ABDE	05:37-06:21	45	20030/15
0185	00	00	00	000	00:00:00.0	0.000N	0.000E		0	0.0	0.0	HEL	EQ	BDE	16:45-17:14	30	20030/16
0186	82	10	20	293	19:23:09.8	33.589N	140.916E	SOUTH OF HONSHU, JAPAN	54	4.9	0.0	PDE	EQ	ABD	19:24-19:38	15	20030/17
0187	82	10	20	293	20:01:56.3	23.837N	121.981E	TAIWAN	20	5.4	5.9	PDE	EQ	A	20:05-20:16	12	20030/18
0188	82	10	21	294	09:47:01.0	19.006S	169.052E	VANUATU IS.	101	5.2	0.0	PDE	EQ	A	09:49-10:00	12	20030/19
0189	82	10	22	295	01:00:30.7	6.323S	130.510E	BANDA SEA	120	5.2	0.0	PDE	EQ	A	01:11-01:22	12	20030/20
0190	82	10	22	295	02:20:37.7	43.496N	146.822E	KURIL IS.	33	5.0	0.0	PDE	EQ	ABDE	02:29-03:13	45	20031/01
0191	82	10	22	295	08:20:58.9	3.450S	177.690E	GILBERT IS. REG.	33	4.8	0.0	PDE	EQ	ABD	08:21-08:35	15	20031/02
0192	82	10	22	295	08:50:30.9	3.552S	177.800E	GILBERT IS. REG.	33	5.0	0.0	PDE	EQ	ABDE	08:51-09:29	39	20031/03
0193	82	10	22	295	10:17:37.5	10.705N	125.484E	LEYTE, PHILIPPINE IS.	45	5.3	4.6	PDE	EQ	A	10:20-10:31	12	20031/04
0194	82	10	22	295	11:32:47.0	40.191N	139.335E	NEAR W. COAST HONSHU, JAPAN	33	4.9	0.0	PDE	EQ	ABD	11:34-11:50	17	20031/05
0195	82	10	23	296	07:08:25.9	1.965S	126.572E	MOLUCCA SEA	33	5.4	4.9	PDE	EQ	A	07:11-07:22	12	20031/06
0196	82	10	23	296	08:00:03.6	7.098S	103.265E	SOUTHWEST OF SUMATERA	33	5.0	0.0	PDE	EQ	A	08:14-08:25	12	20031/07
0197	82	10	23	296	09:26:37.0	5.272N	126.706E	MINDINAO, PHILIPPINE IS.	63	4.8	0.0	PDE	EQ	A	09:29-09:40	12	20031/08
0198	82	10	24	297	01:10:25.3	8.472N	126.953E	MINDINAO, PHILIPPINE IS.	33	5.0	0.0	PDE	EQ	A	01:13-01:24	12	20031/09
0199	82	10	24	297	05:45:54.6	3.280S	177.494E	GILBERT IS. REG.	33	4.7	0.0	PDE	EQ	ABD	05:46-06:00	15	20031/10
0200	82	10	24	297	15:35:25.6	3.701S	131.179E	WEST IRIAN REG.	33	5.3	0.0	PDE	EQ	A	15:38-15:49	12	20031/11

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 5 JUL 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT NO	YR	MO	DA	JUL	HR:MN:SECS	LAT	LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	MAGNI SRF	INF SRC	EV TP	PHASES	SAVED INTERVAL	MNS	STRIP TAPE/FILE
0201	82	10	24	297	16:09:05.5	3.739S	131.194E	WEST IRIAN REG.	33	4.9	0.0	PDE	EQ	A	16:12-16:23	12	20011/ 12
0202	82	10	24	297	22:28:20.5	53.752S	141.746E	W. OF MACQUARIE IS.	10	4.0	5.3	PDE	EQ	A	22:35-22:46	12	20011/ 13
0203	82	10	25	298	12:30:24.5	18.198S	173.928W	TONGA ISLANDS	142	4.6	0.0	PDE	FO	A	12:33-12:44	12	20011/ 14
0204	00	00	00	000	00:00:00.0	0.000N	0.000E		0	0.0	0.0	HEL	EQ	ABDE	12:51-13:29	39	20011/ 15
0205	82	10	25	298	14:26:49.5	4.802S	152.327E	NEW BRITAIN REG.	86	5.4	0.0	PDE	EQ	ABDE	14:27-15:08	42	20011/ 16
0206	82	10	25	298	19:23:52.0	23.604S	179.251E	S. OF FIJI ISLANDS	673	4.8	0.0	PDE	EQ	A	19:26-19:37	12	20011/ 17
0207	82	10	25	298	22:26:04.4	36.322N	120.520W	CENTRAL CALIFORNIA	11	5.4	5.2	PDE	EQ	ABD	22:32-22:56	25	20011/ 18
0208	82	10	26	299	07:33:07.6	85.992N	84.021E	NORTH OF SEVERNAYA ZEMLYA	10	4.6	0.0	PDE	EQ	A	07:39-07:51	13	20011/ 19
0209	82	10	26	299	12:44:18.1	7.446S	105.653E	JAVA	119	5.6	0.0	PDE	EQ	A	12:50-13:01	12	20011/ 20
0210	82	10	27	300	05:45:32.3	46.896N	152.478E	KURIL IS.	33	4.9	0.0	PDE	EQ	ABD	05:46-06:02	17	20011/ 21
0211	82	10	27	300	10:30:13.9	20.484N	121.596E	PHILIPPINE IS. REGION	47	5.5	4.5	PDE	EQ	A	10:33-10:44	12	20011/ 22
0212	82	10	27	300	15:36:36.3	23.830N	105.807E	YUNNAN PROVINCE, CHINA	33	5.2	5.1	PDE	EQ	A	15:41-15:52	12	20011/ 23
0213	82	10	27	300	17:49:15.0	36.389N	69.465E	HINDU KUSH	51	4.0	0.0	PDE	EQ	A	17:57-18:08	12	20011/ 24
0214	82	10	28	301	03:28:36.5	37.335N	134.887E	SEA OF JAPAN	351	4.0	0.0	PDE	EQ	ABDE	03:30-04:17	48	20012/ 01
0215	82	10	28	301	15:30:15.2	7.992S	109.144E	JAVA	98	5.1	0.0	PDE	EQ	A	15:35-15:47	13	20012/ 02
0216	82	10	28	301	18:30:29.2	46.447N	144.067E	SEA OF OKHOTSK	284	4.4	0.0	PDE	EQ	ABD	18:31-18:48	18	20012/ 03
0217	82	10	29	302	02:42:15.5	4.569S	152.462E	NEW BRITAIN REGION	100	5.1	0.0	PDE	EQ	ABDE	02:43-03:24	42	20012/ 04
0218	82	10	29	302	01:04:44.9	16.998S	173.768W	TONGA ISLANDS	124	4.8	0.0	PDE	EQ	A	01:07-01:18	12	20012/ 04
0219	82	10	29	302	03:47:25.4	6.051S	132.426E	BANDA SEA	190	5.6	0.0	PDE	EQ	A	03:50-04:01	12	20012/ 05
0220	82	10	29	302	20:13:06.0	8.114S	107.172E	JAVA	33	5.1	4.8	PDE	EQ	A	20:19-20:30	12	20012/ 06
0221	82	10	30	303	16:30:00.1	12.176S	167.432E	SANTA CRUZ ISLANDS	327	5.3	0.0	PDE	EQ	ABDE	16:31-17:16	46	20012/ 07
0222	82	10	31	304	02:36:58.6	11.636S	117.722E	SOUTH OF SUMBAWA ISLAND	33	5.1	0.0	PDE	EQ	A	02:42-02:53	12	20012/ 08
0223	82	10	31	304	00:48:26.6	18.662S	169.088E	VANUATU ISLANDS	209	4.7	0.0	PDE	EQ	ABD	00:50-01:08	19	20012/ 08
0224	82	10	31	304	01:30:41.2	6.642S	130.508E	BANDA SEA	100	5.0	0.0	PDE	EQ	A	01:34-01:45	12	20012/ 09
0225	82	10	31	304	02:48:13.5	2.944N	96.126E	NORTHERN SUMATERA	61	5.5	0.0	PDE	EQ	A	02:54-03:05	12	20012/ 10
0226	82	10	31	304	18:40:52.8	35.921N	82.516E	TIBET	33	5.2	5.1	PDE	EQ	A	18:47-18:59	13	20012/ 11
0227	82	10	31	304	19:12:46.2	9.672N	126.095E	MINDANAO, PHILIPPINE IS.	68	4.7	0.0	PDE	EQ	A	19:15-19:26	12	20012/ 12
0228	82	10	31	304	22:17:30.2	6.057S	105.540E	SUNDA STRAIT	69	5.0	0.0	PDE	EQ	A	22:23-22:34	12	20012/ 13
0229	82	11	01	305	08:47:55.2	31.397N	141.755E	SOUTH OF HONSHU, JAPAN	33	4.2	0.0	PDE	EQ	ABD	08:46-09:02	15	20012/ 14
0230	82	11	01	305	23:31:56.2	25.023S	179.751E	SOUTH OF FIJI IS.	543	4.9	0.0	PDE	EQ	A	23:34-23:46	13	20012/ 15
0231	82	11	02	306	07:40:27.7	12.397N	125.666E	SAMAR, PHILIPPINE IS.	33	5.1	4.2	PDE	EQ	A	07:43-07:54	12	20012/ 16
0232	82	11	02	306	18:38:04.6	55.494S	124.485W	EASTER IS. CORDILLERA	10	5.4	5.1	PDE	EQ	ABDE	18:46-20:42	117	20012/ 17
0233	82	11	03	307	14:48:04.5	3.234S	139.692E	WEST IRIAN	33	5.3	0.0	PDE	EQ	A	14:50-15:01	12	20012/ 18
0234	82	11	03	307	18:07:47.9	25.167S	179.724E	SOUTH OF FIJI IS.	486	5.3	0.0	PDE	EQ	A	18:10-18:22	13	20012/ 19
0235	82	11	04	308	03:08:32.1	22.705N	121.643E	TAIWAN REGION	143	5.0	0.0	PDE	EQ	A	03:11-03:22	12	20013/ 01
0236	82	11	04	308	09:29:53.3	44.088N	147.982E	KURIL IS.	38	5.7	5.1	PDE	EQ	ABDE	09:31-10:14	44	20013/ 02
0237	82	11	04	308	15:54:13.1	38.548N	143.424E	OFF EAST COAST OF HONSHU, JAPA	33	5.4	4.9	PDE	EQ	ABDE	15:55-16:37	43	20013/ 03
0238	82	11	04	308	18:49:17.3	15.260S	167.469E	VANUATU IS.	115	5.2	0.0	PDE	EQ	A	18:51-19:02	12	20013/ 04
0239	82	11	05	309	03:50:32.1	3.598S	177.703E	GILBERT IS. REGION	33	5.0	0.0	PDE	EQ	ABDE	03:51-04:29	39	20013/ 05
0240	82	11	05	309	04:52:02.3	3.633S	128.671E	CERAM	114	5.3	0.0	PDE	EQ	A	04:55-05:06	12	20013/ 06
0241	82	11	05	309	06:31:53.0	26.105S	170.216E	NORFOLK IS. REGION	33	5.7	0.0	PDE	EQ	A	06:35-06:46	12	20013/ 07
0242	00	00	00	000	00:00:00.0	0.000N	0.000E	POSSIBLY MARIANAS	0	0.0	0.0	HEL	EQ	BD	16:25-16:39	15	20013/ 08
0243	82	11	05	309	16:59:36.8	7.155S	129.622E	BANDA SEA	143	5.2	0.0	PDE	EQ	A	19:03-19:14	12	20013/ 09
0244	82	11	06	310	07:45:49.2	3.556N	126.631E	TALAUD IS.	63	5.2	0.0	PDE	EQ	A	07:49-08:00	12	20013/ 10
0245	82	11	07	311	07:21:35.6	20.216S	173.002W	TONGA IS. REGION	33	5.1	5.1	PDE	EQ	A	07:24-07:36	13	20013/ 11
0246	82	11	07	311	08:38:30.5	6.482S	130.262E	BANDA SEA	107	5.0	0.0	PDE	EQ	A	08:41-08:53	13	20013/ 12
0247	82	11	07	311	15:31:56.4	3.985S	154.479E	NORTH OF SOLOMON IS.	488	4.6	0.0	PDE	EQ	ABD	15:32-15:47	16	20013/ 13
0248	82	11	08	312	07:56:00.2	25.375S	177.167W	SOUTH OF FIJI IS.	150	5.2	0.0	PDE	EQ	A	07:59-08:10	12	20013/ 14
0249	82	11	08	312	09:44:06.9	55.789S	27.061W	SOUTH OF SANDWICH IS. REGION	33	5.4	5.3	PDE	EQ	A	09:53-10:12	20	20013/ 15
0250	82	11	08	312	11:35:42.1	8.855S	119.260E	FLORES IS. REGION	103	5.1	0.0	PDE	EQ	A	11:40-11:51	12	20013/ 16
0251	82	11	08	312	16:40:07.4	55.040N	165.687E	KOMANDORSKY IS. REGION	33	5.2	0.0	PDE	EQ	ABDE	16:42-17:32	51	20013/ 17
0252	82	11	08	312	16:48:26.2	3.616S	177.760E	GILBERT IS. REGION	33	5.0	0.0	PDE	EQ	ABDE	16:49-17:27	39	20013/ 17
0253	82	11	08	312	18:35:34.8	4.827N	127.035E	TALAUD IS.	161	5.4	0.0	PDE	EQ	A	18:38-18:49	12	20013/ 18
0254	82	11	09	313	00:46:56.1	21.303S	178.734W	FIJI IS. REGION	556	5.2	0.0	PDE	EQ	A	00:49-01:00	12	20013/ 19
0255	82	11	09	313	01:36:35.4	7.236N	94.437E	NICOBAR IS. REGION	33	5.2	4.7	PDE	EQ	A	01:43-01:54	12	20013/ 20
0256	82	11	09	313	09:25:20.4	3.447S	177.708E	GILBERT IS. REGION	33	5.2	0.0	PDE	EQ	ABDE	09:25-10:04	40	20013/ 21
0257	82	11	10	314	07:36:23.0	44.171N	149.532E	KURIL IS.	33	5.1	0.0	PDE	EQ	ABDE	07:37-08:20	44	20014/ 01
0258	82	11	10	314	13:23:16.8	33.903N	137.070E	NEAR S. COAST OF HONSHU JAPAN	347	4.6	0.0	PDE	EQ	ABD	13:24-13:40	17	20014/ 02
0259	82	11	10	314	21:20:45.8	15.454S	176.022W	FIJI IS. REGION	33	5.5	5.7	PDE	EQ	A	21:23-21:34	12	20014/ 03
0260	82	11	11	315	00:43:45.7	6.677S	101.671E	SOUTHWEST OF SUMATERA	33	6.1	5.9	PDE	EQ	A	00:50-01:01	12	20014/ 04
0261	82	11	11	315	01:55:37.2	44.237N	149.515E	KURIL IS.	46	5.4	5.2	PDE	EQ	ABDE	01:56-02:39	44	20014/ 05
0262	82	11	11	315	02:01:15.1	44.330N	149.488E	KURIL IS.	41	5.0	0.0	PDE	EQ	ABDE	02:02-02:45	44	20014/ 05
0263	82	11	11	315	02:52:09.3	44.113N	149.595E	KURIL IS.	41	5.3	5.2	PDE	EQ	ABDE	02:53-03:35	43	20014/ 06
0264	82	11	11	315	04:14:34.6	44.217N	149.314E	KURIL IS.	33	5.0	0.0	PDE	EQ	ABDE	04:15-04:58	44	20014/ 07
0265	82	11	11	315	11:55:58.9	6.190S	145.369E	EAST PAPUA NEW GUINEA REG.	49	5.4	0.0	PDE	EQ	ABDE	11:57-12:43	47	20014/ 08
0266	82	11	11	315	21:21:22.4	27.431S	176.735W	KERMADEC IS REGION	33	5.3	5.5	PDE	EQ	A	21:25-21:36	12	20014/ 09
0267	82	11	12	316	12:16:06.2	1.478N	126.459E	MOLUCCA PASSAGE	44	5.5	4.6	PDE	EQ	A	12:19-12:30	12	20014/ 10
0268	82	11	12	316	19:17:00.1	37.024N	116.032W	SOUTHERN NEVADA	0	4.4	0.0	PDE	NX	A	19:23-19:34	12	20014/ 11
0269	82	11	12	316	22:00:54.0	43.753N	150.075E	KURIL IS. REGION	33	5.1	0.0	PDE	EQ	ABDE	22:10-22:52	43	20014/ 12
0270	82	11	13	317	01:20:59.2	17.879S	176.386W	FIJI IS. REGION	33	5.0	4.9	PDE	EQ	A	01:23-01:35	13	20014/ 13
0271	82	11	13	317	05:43:47.4	3.385S	146.835E	BISMARCK SEA	7	5.3	5.1	PDE	EQ	ABDE	05:45-06:28	44	20014/ 14
0272	82	11	13	317	07:31:29.1	18.568S	167.241E	VANUATU ISLANDS	36	5.0	0.0	PDE	EQ	A	07:34-07:45	12	20014/ 15
0273	82	11	13	317	10:21:13.4	6.072S	105.355E	SUNDA STRAIT	58	5.1	0.0	PDE	EQ	A	10:27-10:38	12	20014/ 16
0274	82	11	13	317	12:14:03.1	44.944N	148.904E	KURIL ISLANDS	33	4.9	0.0	PDE	EQ	ABD	12:15-12:30	16	20014/ 17
0275	82	11	13	317	15:44:46.1	44.385N	129.490W	OFF COAST OF OREGON	10	5.1	5.1	PDE	EQ	A	15:50-16:01	12	20014/ 18
0276	82	11	13	317	18:22:50.8	11.978N	143.812E	SOUTH OF MARIANA IS.	15	5.3	5.0	PDE	EQ	ABDE	18:23-18:58	36	20015/ 01
0277	82	11	13	317	18:28:16.6	12.049N	143.700E	SOUTH OF MARIANA IS.	17	5.5	4.9	PDE	EQ	ABDE	18:28-19:04	37	20015/ 01
0278	82	11	14	318	08:29:10.0	52.977N	158.697E	NEAR EAST COAST OF KAMCHATKA	70	5.9	0.0	PDE	EQ	ABDE	08:31-09:19	49	20015/ 02
0279	82	11	14	318	16:23:57.3	9.419S	122.584E	SAVU SEA	60	5.5	0.0	PDE	EQ	A	16:28-16:39	12	20015/ 03
0280	82	11	14	318	17:29:24.2	0.908N	29.095W	CENTRAL MID-ATLANTIC RIDGE	10	5.1	5.1	PDE	EQ	A	17:38-17:58	21	20015/ 04
0281	82	11	15	319	07:59:29.3	26.271N	124.905E	NORTHEAST OF TAIWAN	202	4.9	0.0	PDE	EQ	A	08:02-08:13	12	20015/ 05
0282	82	11	15	319	14:15:25.4	25.500S	13.855W	SOUTH ATLANTIC RIDGE	10	5.2	5.0	PDE	EQ	A	14:24-14:44	21	20015/ 06
0283	82	11	15	319	15:25:52.2	28.668N	138.070E	BONIN IS. REGION	519	4.7	0.0	PDE	EQ	ABD	15:26-15:41	16	20015/ 07
0284	82	11	16	320	17:25:54.1	14.620S	168.040E	VANUATU IS.	33	5.9	5.5	PDE	EQ	ABDE	17:27-18:15	49	20015/ 08
0285	82	11	16	320	17:41:05.9	14.500S	167.962E	VANUATU IS.	33	5.1	0.0	PDE	EQ	A	17:43-17:54	12	20015/ 08
0286	82	11	17	321	09:43:42.4	5.887S	147.167E	EAST PAPUA NEW GUINEA REGION	78	5.5	0.0	PDE	EQ	ABDE	09:45-10:30	46	20015/ 09
0287	82	11	17	321	17:08:29.3	6.113S	150.035E	NEW BRITAIN REGION	57	5.2	4.3	PDE	EQ	ABDE	17:09-17:52	44	20015/ 10
0288	82	11	18	322	10:00:31.2	24.016N	125.062E	SOUTHWESTERN RYUKYU ISLANDS	33	5.0	0.0	PDE	EQ	A	10:03-10:14	12	20015/ 11
0289	82	11	18	322	10:59:21.2	5.767S	152.367E	NEW BRITAIN REGION	33	4.7	0.0	PDE	EQ	ABD	11:00-11:15	16	20015/ 12
0290	82	11	18	322	14:57:51.7	1.720S	76.741W	ECUADOR	195	6.0	0.0	PDE	EQ	A	15:07-15:26	20	20015/ 13
0291	82	11	18	322	22:40:03.7	3.634S	140.070E	WEST IRIAN	71	5.5	0.0	PDE	EQ	A	22:42-22:53	12	20015/ 14
0292	82	11	19	323	04:27:16.4	10.594S	74.753W	PERU	33	6.3	6.3	PDE	EQ	E	04:30-06:59	150	20016/ 01
0293	82	11	19	323	07:52:43.7	1.203N	121.962E	MINAHASSSA PENINSULA	42	5.2	0.0	PDE	EQ	A	07:56-08:07	12	20016/ 02
0294	82	11	19	323	23:05:04.7	45.964N	142.615E	HOKKAIDO, JAPAN REGION	325	4.4	0.0	PDE	EQ	ABD	23:06-23:23	18	20016/ 03
0295	82	11	20	324	03:18:00.6	5.705S	143.730E	NEW BRITAIN REGION	134	5.2	0.0	PDE	EQ	ABDE	03:19-04:02	44	20016/ 04
0296	82	11	20	324	07:58:46.0	34.610N	70.560E	AFGHANISTAN	31	5.7	5.2	PDE	EQ	A	08:06-08:17	12	20016/ 05
0297	82	11	20	324	23:18:42.1	55.143N	162.752E	NEAR EAST COAST OF KAMCHATKA	33	4.8	0.0	PDE	EQ	ABD	23:21-23:37	17	20016/ 06
0298	82	11	20	324	23:34:35.1	7.514S	128.476E	BANDA SEA	120	5.1	0.0	PDE	EQ	A	23:38-23:49	12	20016/ 06
0299	82	11	21	325	14:46:10.2	52.713N	160.950E	OFF EAST COAST OF KAMCHATKA	33	5.2	4.2	PDE	EQ	ABDE	14:48-15:36	49	20016/ 07
0300	82	11	21	325	20:37:09.2	41.981N	142.583E	HOKKAIDO, JAPAN REGION	65	4.9	0.0	PDE	EQ	ABD	20:30-20:54	17	20016/ 08

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTIN. 5 JUL 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST HEL=HELI.ORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT NO	YR	MO	DA	JUL	HR:MN:SECS	LAT	LON	LOCATION DESCRIPTION	DEP KM	MAG BDY	MAG SRF	INF SRC	EV TP	PHASES	SAVED INTERVAL	MNS	STRIP TAPE/FILE
0301	82	11	21	325	23:27:11.7	55.432N	163.222E	OFF EAST COAST OF KAMCHATKA	35	5.7	6.1	PDE	EQ	ABDE	23:29-00:20	52	20016/ 09
0302	82	11	22	326	00:25:20.3	55.627N	163.153E	OFF EAST COAST OF KAMCHATKA	33	4.7	0.0	PDE	EQ	ABD	00:27-00:44	18	20016/ 10
0303	82	11	22	326	02:20:03.7	7.255S	132.145E	TANIMBAR ISL. REGION	85	5.5	0.0	PDE	EQ	A	02:31-02:42	12	20016/ 10
0304	82	11	22	326	01:07:59.0	39.712N	77.718E	SOUTHERN SINKIANG PROV., CHINA	33	5.1	0.0	PDE	EQ	A	01:15-01:26	12	20016/ 11
0305	82	11	22	326	01:26:27.7	55.667N	163.221E	OFF EAST COAST OF KAMCHATKA	33	4.7	0.0	PDE	EQ	ABD	01:28-01:45	18	20016/ 12
0306	82	11	22	326	05:32:51.2	23.740S	176.064W	SOUTH OF FIJI IS.	82	5.4	0.0	PDE	EQ	A	05:36-05:47	12	20016/ 13
0307	82	11	22	326	06:19:48.4	32.250S	178.273W	SOUTH OF KERMADEC IS.	33	5.3	0.0	PDE	EQ	A	06:24-06:35	12	20016/ 14
0308	82	11	22	326	23:00:04.6	32.283S	178.484W	SOUTH OF KERMADEC IS.	80	5.1	0.0	PDE	EQ	A	23:12-23:23	12	20017/ 01
0309	82	11	23	327	06:45:47.8	3.744S	101.700E	SOUTHERN SUMATERA	75	5.1	0.0	PDE	EQ	A	06:52-07:03	12	20017/ 02
0310	82	11	23	327	16:59:29.8	23.955S	175.478W	TONGA IS. REGION	33	5.2	0.0	PDE	EQ	A	19:03-19:14	12	20017/ 03
0311	82	11	25	329	07:31:13.9	3.387S	177.639E	GILBERT IS. REGION	33	5.2	0.0	PDE	EQ	ABDE	07:31-08:10	40	20017/ 04
0312	82	11	25	329	18:08:59.6	36.732N	71.474E	AFGHANISTAN-USSR BORDER REGION	124	4.7	0.0	PDE	EQ	A	18:16-18:27	12	20017/ 05
0313	82	11	25	329	18:55:29.1	30.006N	132.263E	SOUTHEAST OF SHIKOKU, JAPAN	33	4.8	0.0	PDE	EQ	ABD	18:57-19:13	17	20017/ 06
0314	82	11	26	330	16:08:27.3	11.857N	142.647E	SOUTH OF MARIANA IS.	33	4.4	0.0	PDE	EQ	ABD	16:09-16:22	14	20017/ 07
0315	82	11	26	330	16:52:01.0	5.020N	125.812E	MINDANAO, PHILIPPINE IS.	33	5.0	0.0	PDE	EQ	A	16:55-17:06	12	20017/ 08
0316	82	11	26	330	17:45:33.8	55.884S	144.220W	SOUTH PACIFIC CORDILLERA	10	5.7	5.3	PDE	EQ	A	17:53-18:04	12	20017/ 09
0317	82	11	27	331	02:19:09.8	32.463S	178.263W	SOUTH OF KERMADEC IS.	52	5.5	0.0	PDE	EQ	A	02:23-02:35	13	20017/ 10
0318	82	11	27	331	03:30:42.1	55.764S	144.309W	SOUTH PACIFIC CORDILLERA	10	5.3	0.0	PDE	EQ	A	03:38-03:49	12	20017/ 11
0319	82	11	27	331	09:55:38.8	50.174N	147.792E	SEA OF OKHOTSK	623	5.6	0.0	PDE	EQ	ABDE	09:56-10:46	51	20017/ 12
0320	82	11	27	331	11:13:51.3	5.296N	125.809E	MINDANAO, PHILIPPINE IS.	142	5.1	0.0	PDE	EQ	A	11:16-11:28	13	20017/ 13
0321	82	11	27	331	14:11:46.3	36.535N	71.069E	AFGHANISTAN-USSR BORDER REGION	18[illegible]	4.2	0.0	PDE	EQ	A	14:19-14:30	12	20017/ 14
0322	82	11	27	331	17:02:44.2	23.544S	175.286W	TONGA IS. REGION	33	5.2	0.0	PDE	EQ	A	17:06-17:17	12	20017/ 15
0323	82	11	27	331	20:30:27.7	39.018N	140.830E	HONSHU, JAPAN	33	4.8	0.0	PDE	EQ	ABD	20:31-20:47	17	20017/ 16
0324	82	11	28	332	11:04:06.9	6.687S	150.523E	NEW BRITAIN REGION	33	5.0	0.0	PDE	EQ	ABDE	11:05-11:49	45	20017/ 17
0325	82	11	28	332	19:05:30.2	2.912S	129.401E	CERAM	33	5.0	0.0	PDE	EQ	A	19:08-19:20	13	20017/ 18
0326	82	11	29	333	14:02:58.6	6.464S	154.399E	SOLOMON IS.	33	0.0	0.0	PDE	EQ	ABD	14:04-14:19	16	20017/ 19
0327	82	11	30	334	02:16:43.9	20.436S	178.053W	FIJI IS. REGION	542	5.2	0.0	PDE	EQ	A	02:19-02:30	12	20017/ 20
0328	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLY MARIANAS	0	0.0	0.0	HEL	EQ	BD	06:52-07:19	26	20017/ 21
0329	82	11	30	334	14:03:00.5	32.249S	178.133W	SOUTH OF KERMADEC IS.	33	5.2	0.0	PDE	EQ	A	14:07-14:18	12	20017/ 22
0330	82	11	30	334	18:54:20.6	8.449S	121.595E	FLORES IS. REGION	20[illegible]	4.7	0.0	PDE	EQ	A	18:58-19:09	12	20017/ 23
0331	82	11	30	334	19:08:32.2	51.977N	158.910E	NEAR EAST COAST OF KAMCHATKA	33	4.7	0.0	PDE	EQ	ABD	19:10-19:26	17	20017/ 23
0332	82	12	01	335	08:39:44.4	31.847N	131.762E	KYUSHU, JAPAN	33	5.0	5.1	PDE	EQ	ABDE	08:41-09:29	49	20018/ 01
0333	82	12	02	336	03:20:14.1	1.199S	23.722W	CENTRAL MID-ATLANTIC RIDGE	10	5.2	4.9	PDE	EQ	A	03:29-03:48	20	20018/ 19
0334	82	12	02	336	09:43:53.7	51.927N	170.473W	FOX IS., ALEUTIAN IS.	33	5.5	4.7	PDE	EQ	ABDE	09:46-10:37	52	20018/ 02
0335	82	12	02	336	15:24:50.1	36.217N	142.629E	OFF EAST COAST OF HONSHU JAPAN	33	4.7	0.0	PDE	EQ	ABD	15:26-15:41	16	0/ 02
0336	82	12	02	336	19:36:56.4	4.542S	138.980E	WEST IRIAN	33	5.6	5.3	PDE	EQ	A	19:39-19:50	12	20018/ 03
0337	82	12	03	337	00:56:10.8	3.889S	151.969E	NEW IRELAND REGION	255	4.9	0.0	PDE	EQ	ABD	00:56-01:11	16	20018/ 04
0338	82	12	03	337	01:38:42.5	23.580S	175.762W	TONGA IS. REGION	33	5.3	5.9	PDE	EQ	A	01:42-01:53	12	20018/ 05
0339	82	12	03	337	16:49:56.6	9.057S	120.340E	SUMBA IS. REGION	33	5.1	0.0	PDE	EQ	A	16:54-17:05	12	20018/ 07
0340	82	12	03	337	22:30:00.1	13.350S	167.206E	VANUATU IS.	260	5.7	0.0	PDE	EQ	A	22:31-22:42	12	20018/ 06
0341	82	12	04	338	02:07:27.9	3.715S	140.022E	WEST IRIAN	33	5.1	0.0	PDE	EQ	A	02:09-02:20	12	20018/ 09
0342	82	12	04	338	07:45:30.4	4.944N	126.055E	TALAUD ISLANDS	10[illegible]	5.0	0.0	PDE	EQ	A	07:48-07:59	12	20018/ 10
0343	82	12	04	338	23:23:44.4	22.937N	142.691E	VOLCANO IS. REGION	276	4.7	0.0	PDE	EQ	ABDE	23:23-23:59	37	20018/ 11
0344	82	12	05	339	01:03:49.9	0.059S	126.434E	MOLUCCA SEA	52	4.9	0.0	PDE	EQ	A	01:07-01:18	12	20018/ 12
0345	82	12	05	339	03:37:12.6	49.907N	78.843E	EASTERN KASAKH SSR	0	6.1	4.4	PDE	NX	A	03:44-03:55	12	20018/ 13
0346	82	12	05	339	05:48:24.1	9.874S	161.181E	SOLOMON ISLANDS	84	5.9	0.0	PDE	EQ	ABDE	05:49-06:32	44	20018/ 14
0347	82	12	05	339	09:04:53.5	23.659S	175.461W	TONGA ISLANDS REGION	33	5.0	5.0	PDE	EQ	A	09:08-09:19	12	20018/ 15
0348	82	12	05	339	13:42:12.0	11.809S	165.126E	SANTA CRUZ ISLANDS	33	5.4	0.0	PDE	EQ	A	13:43-13:55	13	20018/ 16
0349	82	12	05	339	15:00:36.8	23.624S	175.627W	TONGA ISLANDS REGION	33	5.4	5.2	PDE	EQ	A	15:04-15:15	12	20018/ 17
0350	82	12	05	339	15:52:22.6	23.489S	175.881W	TONGA ISLANDS REGION	33	5.5	5.7	PDE	EQ	A	15:56-16:07	12	20018/ 18
0351	82	12	06	340	14:03:31.6	36.321N	141.262E	NEAR EAST COAST OF HONSHU, JAP	59	4.7	0.0	PDE	EQ	ABD	14:04-14:19	16	20018/ 20
0352	82	12	07	341	05:43:49.6	36.025N	114.825W	SOUTHERN NEVADA	5	0.0	0.0	PDE	EQ	A	09:50-10:01	12	20018/ 21
0353	82	12	07	341	12:12:09.1	45.551N	146.005E	KURIL ISLANDS	117	4.8	0.0	PDE	EQ	ABD	12:13-12:29	17	20018/ 22
0354	82	12	08	342	00:41:34.1	14.235N	146.126E	MARIANA ISLANDS	66	4.9	0.0	PDE	EQ	ABD	00:41-00:54	14	0/ 00
0355	82	12	08	342	10:54:12.6	3.472S	177.577E	GILBERT ISLANDS REGION	33	5.1	0.0	PDE	EQ	A	10:54-11:06	13	0/ 00
0356	82	12	08	342	16:30:51.0	0.632N	119.918E	MINAHASSA PENINSULA	87	5.0	0.0	PDE	EQ	A	16:34-16:46	13	0/ 00
0357	82	12	08	342	18:04:47.1	41.364S	87.626W	WEST CHILE RISE	10	5.4	0.0	PDE	EQ	A	18:14-18:33	20	0/ 00
0358	82	12	09	343	01:41:37.6	29.009S	112.655W	EASTER ISLAND REGION	10	5.6	5.9	PDE	EQ	ABDE	01:50-03:42	113	0/ 00
0359	82	12	09	343	05:28:40.1	3.481S	177.616E	GILBERT ISLANDS REGION	33	5.6	5.2	PDE	EQ	ABDE	05:29-06:07	39	0/ 00
0360	82	12	09	343	10:39:40.3	21.025S	168.527E	LOYALTY ISLANDS	33	5.4	5.0	PDE	EQ	A	10:42-10:53	12	20018/ 23
0361	82	12	09	343	18:58:35.7	47.833N	155.246E	KURIL ISLANDS REGION	33	5.2	0.0	PDE	EQ	ABDE	19:00-19:43	44	20019/ 01
0362	82	12	10	344	14:49:35.7	45.177N	148.613E	KURIL ISLANDS	119	4.9	0.0	PDE	EQ	ABD	14:50-15:06	17	20019/ 02
0363	82	12	10	344	15:20:00.0	37.030N	116.072W	SOUTHERN NEVADA	0	4.8	0.0	PDE	NX	A	15:26-15:37	12	20019/ 03
0364	82	12	10	344	17:20:59.9	26.442S	176.570W	SOUTH OF FIJI ISLANDS	33	5.2	5.1	PDE	EQ	A	17:24-17:36	13	20019/ 04
0365	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO SO T	0	0.0	0.0	HEL	EQ	BDE	19:10-19:44	35	20019/ 05
0365	00	02	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO SO T	0	0.0	0.0	HEL	EQ	BDE	23:19-00:07	49	20019/ 06
0367	82	12	11	345	16:46:31.4	11.377S	119.813E	SOUTH OF SUMBA ISLAND	33	5.7	0.0	PDE	EQ	A	16:51-17:02	12	20019/ 07
0368	82	12	12	346	17:10:09.2	17.810N	145.616E	MARIANA ISLANDS	326	4.9	0.0	PDE	EQ	ABDE	17:09-17:42	34	20019/ 08
0369	82	12	13	347	02:50:51.6	63.275S	61.237W	SOUTH SHETLAND ISLANDS	33	5.7	5.4	PDE	EQ	A	03:00-03:19	20	20019/ 09
0370	82	12	13	347	09:12:49.4	14.750N	44.287E	WESTERN ARABIAN PENINSULA	10	5.9	6.0	PDE	EQ	AE	09:22-11:41	140	20019/ 10
0371	82	12	13	347	10:25:05.5	18.111S	178.476W	FIJI IS. REGION	645	4.7	0.0	PDE	EQ	A	10:27-10:38	12	20019/ 10
0372	82	12	14	348	02:37:10.5	20.535S	169.487E	VANUATU IS	207	5.2	0.0	PDE	EQ	A	02:39-02:51	13	20019/ 11
0373	82	12	14	348	12:02:05.8	23.653S	175.805W	TONGA IS. REGION	33	5.4	5.6	PDE	EQ	A	12:05-12:17	13	20019/ 12
0374	82	12	14	348	23:11:07.7	23.157S	178.612W	SOUTH OF FIJI IS.	548	5.9	0.0	PDE	EQ	A	23:13-23:25	13	20019/ 13
0375	82	12	15	349	10:17:21.8	18.177S	178.321W	FIJI IS. REGION	652	5.0	0.0	PDE	EQ	A	10:19-10:30	12	20019/ 14
0376	82	12	16	350	00:40:48.6	36.242N	69.096E	HINDU KUSH REGION	35	6.2	6.6	PDE	EQ	AE	00:48-02:33	106	20020/ 01
0377	82	12	16	350	05:27:53.1	36.356N	69.595E	HINDU KUSH REGION	33	5.0	0.0	PDE	EQ	A	05:35-05:46	12	20020/ 02
0378	82	12	16	350	08:56:30.0	11.689N	92.993E	ANDAMAN IS. REGION	86	5.3	0.0	PDE	EQ	A	09:03-09:14	12	20020/ 03
0379	82	12	16	350	17:04:26.9	1.342N	126.942E	MOLUCCA PASSAGE	69	5.4	0.0	PDE	EQ	A	17:07-17:18	12	20020/ 04
0380	82	12	16	350	21:01:30.2	36.174N	68.904E	HINDU KUSH REGION	33	5.0	4.0	PDE	EQ	A	21:09-21:20	12	20020/ 05
0381	82	12	17	351	02:43:01.9	24.642N	122.616E	TAIWAN REGION	73	6.2	0.0	PDE	EQ	A	02:46-02:57	12	20020/ 06
0382	82	12	17	351	11:52:57.7	3.502S	177.716E	GILBERT IS. REGION	33	5.0	0.0	PDE	EQ	ABDE	11:53-12:32	40	20020/ 07
0383	82	12	17	351	21:15:01.6	26.671S	176.277W	SOUTH OF FIJI ISLANDS	33	5.3	5.6	PDE	EQ	A	21:19-21:30	12	20020/ 08
0384	82	12	18	352	00:41:16.6	1.750N	125.634E	MOLUCCA PASSAGE	47	5.6	5.1	PDE	EQ	A	00:44-00:55	12	20020/ 09
0385	82	12	18	352	08:26:47.5	25.675S	176.574W	SOUTH OF FIJI ISLANDS	33	5.3	0.0	PDE	EQ	A	08:30-08:42	13	20020/ 10
0386	8[illegible]	[illegible]	18	352	21:11:36.2	6.837S	125.117E	BANDA SEA	561	4.7	0.0	PDE	EQ	A	21:14-21:26	13	20020/ 11
0387	[illegible]	[illegible]	19	353	00:06:19.8	32.478S	178.457W	SOUTH OF KERMADEC ISLANDS	33	5.8	5.2	PDE	EQ	A	00:10-00:22	13	20020/ 12
0388	82	12	19	353	00:33:49.4	32.472S	179.323W	SOUTH OF KERMADEC ISLANDS	33	5.6	5.5	PDE	EQ	A	00:38-00:49	12	20020/ 13
0389	82	12	19	353	06:24:39.6	6.311S	100.784E	SOUTHWEST OF SUMATERA	33	5.4	0.0	PDE	EQ	A	06:31-06:42	12	20020/ 14
0390	82	12	19	353	13:00:15.4	24.255S	175.932W	SOUTH OF TONGA ISLANDS	33	5.5	5.6	PDE	EQ	A	13:03-13:15	13	20020/ 15
0391	82	12	19	353	17:43:55.9	24.188S	175.773W	SOUTH OF TONGA ISLANDS	33	6.0	7.7	PDE	EQ	ABDE	17:47-18:49	63	20020/ 16
0392	82	12	19	353	18:33:16.0	23.905S	175.421W	TONGA ISLANDS REGION	33	5.7	0.0	PDE	EQ	A	18:36-18:48	13	20020/ 16
0393	82	12	19	353	18:49:02.3	23.429S	175.224W	TONGA ISLANDS REGION	33	5.4	0.0	PDE	EQ	A	18:52-19:04	13	20020/ 17
0394	82	12	19	353	20:14:19.7	24.596S	175.483W	SOUTH OF TONGA ISLANDS	33	5.4	0.0	PDE	EQ	A	20:18-20:29	12	20020/ 18
0395	82	12	19	353	20:40:05.6	23.842S	175.72[illegible]W	TONGA ISLANDS REGION	33	5.6	0.0	PDE	EQ	A	20:51-21:03	13	20020/ 19
0396	82	12	19	353	21:26:08.2	23.924S	175.565W	TONGA ISLANDS REGION	33	5.6	0.0	PDE	EQ	A	21:29-21:41	13	20020/ 20
0397	82	12	19	353	21:31:33.2	23.572S	175.8[illegible]W	TONGA ISLANDS REGION	100	4.7	0.0	PDE	EQ	A	21:35-21:46	12	20020/ 20
0398	82	12	19	353	21:41:56.5	3.459S	177.7[illegible]E	GILBERT ISLANDS REGION	33	5.1	0.0	PDE	EQ	ABDE	21:42-22:21	40	20020/ 20
0399	82	12	19	353	23:41:08.1	24.513S	175.8[illegible]W	SOUTH OF TONGA ISLANDS	33	5.6	5.2	PDE	EQ	A	23:44-23:56	13	20021/ 01
0400	82	12	20	354	00:33:[illegible].9	57.362S	25.692W	SOUTH SANDWICH ISL. REGION	33	6.0	5.1	PDE	EQ	A	00:42-01:01	20	20021/ 02

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 5 JUL 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT NO	YR	MO	DA	JUL	ORIGIN TIME HR:MN:SECS	COORDINATES LAT	COORDINATES LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	MAGNI SRF	INF SRC	EV TP	SAVED PHASES	SAVED INTERVAL	MNS	STRIP TAPE/FILE
0401	82	12	20	354	01:30:30.3	24.060S	175.500W	SOUTH OF TONGA ISLANDS	33	5.5	6.0	PDE	EQ	AE	01:34-02:36	63	20021/ 03
0402	82	12	20	354	02:58:10.6	23.693S	176.025W	SOUTH OF FIJI ISLANDS	33	5.7	6.3	PDE	EQ	AE	03:01-04:03	63	20021/ 04
0403	82	12	20	354	05:54:37.5	24.504S	175.985W	SOUTH OF TONGA ISLANDS	33	5.9	5.8	PDE	EQ	A	05:58-[illegible]09	12	20021/ 05
0404	82	12	20	354	07:14:28.7	24.604S	175.623W	SOUTH OF TONGA ISLANDS	33	5.3	0.0	PDE	EQ	A	07:18-07:29	12	20021/ 06
0405	82	12	20	354	07:56:42.0	24.542S	175.909W	SOUTH OF TONGA ISLANDS	33	5.6	5.1	PDE	EQ	A	08:00-08:11	12	20021/ 07
0406	82	12	20	354	12:34:59.3	24.602S	175.991W	SOUTH OF TONGA ISLANDS	33	5.5	5.6	PDE	EQ	A	12:38-12:52	13	20021/ 08
0407	82	12	20	354	14:35:45.4	24.564S	175.848W	SOUTH OF TONGA ISLANDS	33	5.7	6.0	PDE	EQ	AE	14:39-15:41	63	20021/ 09
0408	82	12	20	354	18:12:22.9	23.821S	175.631W	TONGA ISLANDS REGION	33	5.5	6.2	PDE	EQ	AE	18:16-19:17	62	20021/ 10
0409	82	12	21	355	01:18:16.1	42.255N	142.396E	HOKKAIDO JAPAN REGION	53	4.7	0.0	PDE	EQ	ABD	01:19-01:35	17	20021/ 11
0410	82	12	21	355	02:19:29.0	24.672S	175.743W	SOUTH OF TONGA ISLANDS	33	5.2	5.4	PDE	EQ	A	02:23-02:34	12	20021/ 12
0411	82	12	21	355	05:48:10.7	3.494S	142.925E	NEAR N COAST PAPUA NEW GUINEA	17	5.1	0.0	PDE	EQ	ABDE	05:50-06:35	46	20021/ 13
0412	82	12	21	355	05:10:23.1	16.172S	172.509W	SAMOA ISLANDS REGION	33	5.2	0.0	PDE	EQ	A	05:13-05:24	12	20021/ 13
0413	82	12	21	355	07:31:47.0	24.239S	175.707W	SOUTH OF TONGA ISLANDS	33	5.0	0.0	PDE	EQ	A	07:35-07:46	12	20021/ 14
0414	82	12	21	355	12:08:46.6	29.221N	81.333E	NEPAL	33	4.7	0.0	PDE	EQ	A	12:16-12:27	12	20021/ 15
0415	82	12	21	355	16:12:18.3	24.744S	175.776W	SOUTH OF TONGA ISLANDS	33	5.3	5.7	PDE	EQ	A	16:16-16:27	12	20021/ 16
0416	82	12	21	355	18:00:27.1	23.620S	175.622W	TONGA ISLANDS REGION	33	5.3	5.2	PDE	EQ	A	15:04-18:15	12	20021/ 17
0417	82	12	21	355	18:43:25.8	23.999S	175.099W	TONGA ISLANDS REGION	33	5.1	0.0	PDE	EQ	A	16:47-18:58	12	20022/ 01
0418	82	12	21	355	23:35:27.9	37.172N	71.743E	AFGHANISTAN-USSR BORDER REGION	160	4.8	0.0	PDE	EQ	A	23:42-23:54	13	20022/ 02
0419	82	12	22	356	15:32:35.3	23.251S	179.035E	SOUTH OF FIJI ISLANDS	573	5.5	0.0	PDE	EQ	A	15:35-15:46	12	20022/ 03
0420	82	12	23	357	00:10:30.1	24.479S	176.218W	SOUTH OF FIJI ISLANDS	33	5.6	5.3	PDE	EQ	A	00:14-00:25	12	20022/ 04
0421	82	12	23	357	02:14:13.2	23.812S	175.949W	TONGA ISLANDS REGION	33	5.4	5.4	PDE	EQ	A	02:17-02:29	13	20022/ 05
0422	82	12	23	357	03:20:30.6	24.587S	176.090W	SOUTH OF FIJI ISLANDS	33	5.4	5.3	PDE	EQ	A	03:24-03:35	12	20022/ 06
0423	82	12	23	357	05:47:24.9	24.186S	175.816W	SOUTH OF TONGA ISLANDS	33	5.1	0.0	PDE	EQ	A	05:51-06:02	12	20022/ 07
0424	82	12	23	357	09:41:47.0	23.778S	175.326W	TONGA ISLANDS REGION	33	5.3	5.1	PDE	EQ	A	09:45-09:56	12	20022/ 08
0425	82	12	23	357	13:05:16.5	23.596S	175.445W	TONGA ISLANDS REGION	33	5.5	5.4	PDE	EQ	A	13:08-13:20	13	20022/ 09
0426	82	12	24	358	04:18:24.2	24.465S	176.103W	SOUTH OF FIJI ISLANDS	33	5.2	5.1	PDE	EQ	A	04:22-04:33	12	20022/ 10
0427	82	12	24	358	06:47:10.0	37.166N	71.794E	AFGHANISTAN-USSR BORDER REGION	148	4.6	0.0	PDE	EQ	A	06:54-09:05	12	20022/ 11
0428	82	12	24	358	10:10:22.6	44.096N	149.511E	KURIL ISLANDS	56	5.2	0.0	PDE	EQ	ABDE	10:11-10:54	44	20022/ 12
0429	82	12	24	358	23:31:03.0	52.521N	173.311E	NEAR ISLANDS, ALEUTIAN ISLANDS	74	5.2	0.0	PDE	EQ	A	23:32-23:44	13	20022/ 13
0430	00	00	00	000	00:00:00.0	0.000N	0.000E	POSSIBLY NEAR WAKE ISLAND	0	0.0	0.0	HEL	EQ	BDE	00:09-00:26	18	20022/ 14
0431	82	12	25	359	04:19:31.9	0.717S	134.871E	WEST IRIAN REGION	51	4.7	0.0	PDE	EQ	A	04:22-04:33	12	20022/ 15
0432	82	12	25	359	07:53:39.3	4.377S	131.454E	BANDA SEA	33	5.1	4.4	PDE	EQ	A	07:56-08:08	13	20022/ 16
0433	82	12	25	359	12:28:00.9	8.431S	123.084E	FLORES ISLAND REGION	22	5.6	5.8	PDE	EQ	A	12:32-12:43	12	20022/ 17
0434	82	12	25	359	16:51:47.3	26.575N	95.846E	BURMA-INDIA BORDER REGION	33	5.0	0.0	PDE	EQ	A	16:57-17:09	13	20022/ 18
0435	82	12	26	360	00:29:36.5	45.252N	151.200E	KURIL ISLANDS	33	5.0	0.0	PDE	EQ	ABDE	00:30-01:13	44	20022/ 19
0436	82	12	26	360	02:20:07.8	23.985S	175.174W	TONGA ISLANDS REGION	33	5.1	0.0	PDE	EQ	A	02:23-02:35	13	20022/ 20
0437	82	12	26	360	02:42:00.3	3.637S	177.692E	GILBERT ISLANDS REGION	33	4.9	0.0	PDE	EQ	ABDE	02:42-03:21	40	20022/ 21
0438	82	12	26	360	03:35:14.3	50.070N	79.009E	EASTERN KAZAKH SSR.	0	5.7	0.0	PDE	NX	A	03:42-03:53	12	20022/ 22
0439	82	12	26	360	05:29:34.0	41.011N	61.693E	UZBEK SSR	33	4.9	0.0	PDE	EQ	A	05:37-05:49	13	20022/ 23
0440	82	12	26	360	09:24:42.7	4.553S	143.650E	PAPUA NEW GUINEA	102	5.3	0.0	PDE	EQ	ABDE	09:26-10:12	47	20022/ 24
0441	82	12	26	360	16:19:57.6	38.278N	141.696E	NEAR EAST COAST OF HONSHU JAPA	73	5.1	0.0	PDE	EQ	ABDE	16:21-17:03	43	20023/ 01
0442	82	12	26	360	23:59:56.3	3.380S	177.796E	GILBERT ISLANDS REGION	33	4.7	0.0	PDE	EQ	ABDE	02:00-[illegible]:38	39	20023/ 02
0443	82	12	27	361	01:32:57.6	19.006N	145.006E	MARIANA ISLANDS	600	5.3	0.0	PDE	EQ	ABDE	01:32-02:05	34	20023/ 03
0444	82	12	27	361	01:50:42.8	11.439S	162.325E	SOLOMON ISLANDS	78	5.0	0.0	PDE	EQ	ABDE	01:52-02:36	45	20023/ 03
0445	00	02	00	000	02:00:00.0	0.002N	0.000E	PROBABLE MARIANAS PO,SO,T	0	0.0	0.0	HEL	EQ	BDE	06:17-06:46	30	20023/ 04
0446	82	12	27	361	07:07:29.4	34.110N	139.138E	NEAR S. COAST OF HONSHU JAPAN	33	5.0	0.0	PDE	EQ	ABDE	07:06-07:51	44	20023/ 05
0447	82	12	27	361	11:33:18.4	33.823N	139.451E	SOUTH OF HONSHU JAPAN	21	5.2	5.0	PDE	EQ	ABDE	11:34-12:16	43	20023/ 06
0448	82	12	27	361	14:07:43.5	34.238N	139.245E	NEAR S. COAST OF HONSHU JAPAN	33	5.0	0.0	PDE	EQ	ABDE	14:08-14:51	44	20023/ 07
0449	82	12	28	362	01:23:47.6	33.806N	139.361E	SOUTH OF HONSHU JAPAN	20	5.0	4.1	PDE	EQ	ABDE	01:25-02:07	43	20023/ 08
0450	82	12	28	362	01:52:31.3	33.707N	139.447E	SOUTH OF HONSHU JAPAN	21	5.3	5.5	PDE	EQ	ABDE	01:53-02:35	43	20023/ 08
0451	82	12	28	362	02:12:14.1	33.578N	139.540E	SOUTH OF HONSHU JAPAN	15	5.2	0.0	PDE	EQ	ABDE	02:13-02:55	43	20023/ 08
0452	82	12	28	362	06:37:42.0	33.739N	139.465E	SOUTH OF HONSHU JAPAN	20	5.9	6.1	PDE	EQ	ABDE	06:38-07:20	43	20023/ 09
0453	82	12	28	362	07:30:07.5	22.355N	100.860E	BURMA-CHINA BORDER REGION	26	5.2	0.0	PDE	EQ	A	07:35-07:46	12	20023/ 10
0454	82	12	28	362	09:00:03.1	25.577N	99.379E	YUNNAN PROVINCE, CHINA	30	5.0	0.0	PDE	EQ	A	08:05-08:17	13	20024/ 01
0455	82	12	28	362	10:03:46.3	18.007N	145.762E	MARIANA ISLANDS	217	4.6	0.0	PDE	EQ	ABDE	10:03-10:35	33	20024/ 02
0456	82	12	28	362	13:49:29.5	19.950N	121.423E	PHILIPPINE ISLANDS REGION	39	5.9	5.9	PDE	EQ	A	13:52-14:04	13	20024/ 03
0457	82	12	28	362	15:53:51.5	23.685S	175.702W	TONGA ISLANDS REGION	33	5.3	5.6	PDE	EQ	A	15:57-16:08	12	20024/ 04
0458	82	12	28	362	16:29:36.3	33.636N	139.674E	SOUTH OF HONSHU JAPAN	33	4.5	5.7	PDE	EQ	ABDE	16:30-17:12	43	20024/ 05
0459	82	12	28	362	21:19:05.0	3.363S	177.713E	GILBERT ISLANDS REGION	33	5.1	0.0	PDE	EQ	ABDE	21:19-21:58	40	20024/ 06
0460	82	12	28	362	21:51:05.1	23.384S	175.635W	TONGA ISLANDS REGION	33	5.0	0.0	PDE	EQ	A	21:54-22:06	13	20024/ 06
0461	82	12	28	362	23:37:06.4	18.194S	178.514W	FIJI ISLANDS REGION	627	4.8	0.0	PDE	EQ	A	23:39-23:50	12	20024/ 07
0462	82	12	29	363	00:09:20.8	30.344N	79.822E	TIBET-INDIA BORDER REGION	33	4.8	0.0	PDE	EQ	A	00:16-00:27	12	20024/ 08
0463	82	12	29	363	00:10:55.0	17.717S	177.446W	FIJI ISLANDS REGION	419	5.1	0.0	PDE	EQ	A	00:13-00:24	12	20024/ 08
0464	82	12	29	363	07:02:31.4	33.724N	139.255E	SOUTH OF HONSHU JAPAN	20	5.5	5.3	PDE	EQ	ABDE	07:03-07:45	43	20024/ 09
0465	82	12	29	363	12:17:45.9	33.782N	139.296E	SOUTH OF HONSHU JAPAN	22	5.3	4.6	PDE	EQ	ABDE	12:19-13:01	43	20024/ 10
0466	82	12	29	363	14:05:40.9	14.866N	120.323E	LUZON PHILIPPINE ISLANDS	107	5.5	0.0	PDE	EQ	A	14:09-14:20	12	20024/ 11
0467	82	12	29	363	15:14:59.6	34.849N	140.396E	NEAR EAST COAST OF HONSHU JAPA	33	5.0	0.0	PDE	EQ	ABDE	15:16-15:57	42	20024/ 12
0469	82	12	29	363	15:21:20.9	29.941N	70.136E	PAKISTAN	33	5.0	4.9	PDE	EQ	A	15:29-15:40	12	20024/ 12
0469	82	12	29	363	16:58:41.7	6.504S	154.529E	SOLOMON ISLANDS	33	5.1	0.0	PDE	EQ	ABDE	16:59-17:41	43	20024/ 13
0470	82	12	30	364	00:51:21.0	24.154S	174.960W	SOUTH OF TONGA ISLANDS	33	5.3	4.9	PDE	EQ	A	00:55-01:06	12	20024/ 14
0471	82	12	30	364	08:37:16.1	25.950N	91.640E	INDIA-BANGLADESH BORDER REGION	64	4.9	0.0	PDE	EQ	A	08:43-08:54	12	20024/ 15
0472	82	12	30	364	12:29:25.7	26.361N	91.971E	EASTERN INDIA	33	5.0	0.0	PDE	EQ	A	12:35-12:47	13	20024/ 16
0473	82	12	30	364	17:50:09.4	6.237S	130.458E	BANDA SEA	137	5.0	0.0	PDE	EQ	A	17:53-18:04	12	20024/ 17
0474	82	12	31	365	09:50:02.0	28.714N	128.463E	RYUKYU ISLANDS	33	5.0	5.4	PDE	EQ	A	10:00-10:11	12	20024/ 18
0475	82	12	31	365	13:41:49.0	3.482S	177.668E	GILBERT ISLANDS REGION	26	5.3	4.4	PDE	EQ	ABDE	13:42-14:20	39	20025/ 01
0476	82	12	31	365	14:43:15.1	5.345N	126.913E	MINDANAO PHILIPPINE ISLANDS	105	5.1	0.0	PDE	EQ	A	14:46-14:57	12	20025/ 02
0477	00	02	00	000	02:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO,SO,T	0	0.0	0.0	HEL	EQ	BDE	23:55-00:29	35	20025/ 03
0478	83	01	01	001	05:31:54.6	17.307S	69.276W	PERU-BOLIVIA BORDER REGION	172	5.7	0.0	PDE	EQ	A	05:41-06:00	20	20025/ 04
0479	83	01	01	001	10:46:12.3	16.990N	147.435E	MARIANA ISLANDS REGION	33	4.7	0.0	PDE	EQ	ABD	10:45-10:58	14	20025/ 05
0480	83	01	01	001	11:18:07.6	61.333N	147.156E	SOUTHERN ALASKA	55	5.3	0.0	PDE	EQ	A	11:21-11:32	12	20025/ 06
0481	83	01	02	002	06:52:32.8	12.140S	166.792E	SANTA CRUZ ISLANDS	33	4.9	0.0	PDE	EQ	ABD	06:54-07:09	16	20025/ 07
0482	83	01	02	002	12:54:06.9	9.760S	159.760E	SOLOMON ISLANDS	33	5.3	0.0	PDE	EQ	ABDE	12:55-13:38	44	20025/ 08
0483	83	01	02	002	18:29:47.2	1.916N	126.808E	MOLUCCA PASSAGE	64	5.4	0.0	PDE	EQ	A	18:33-18:44	12	20025/ 09
0484	83	01	02	002	22:09:07.5	20.753S	178.728W	FIJI ISLANDS REGION	621	5.2	0.0	PDE	EQ	A	22:11-22:22	12	20025/ 10
0485	83	01	02	002	23:58:11.9	6.722N	126.866E	MINDANAO PHILIPPINE ISLANDS	55	5.2	0.0	PDE	EQ	A	00:01-00:12	12	20025 11
0486	83	01	03	003	03:39:46.7	4.083S	103.145E	SOUTHERN SUMATERA	56	5.5	5.2	PDE	EQ	A	03:46-03:57	12	20025/ 12
0487	83	01	03	003	06:04:08.7	59.502S	26.346W	SOUTH SANDWICH ISLANDS REGION	107	5.6	0.0	PDE	EQ	A	06:13-06:32	20	20025/ 13
0488	83	01	03	003	11:20:14.0	24.207N	94.481E	BURMA-INDIA BORDER REGION	74	5.2	0.0	PDE	EQ	A	11:34-11:45	12	20025/ 14
0489	83	01	03	003	18:53:29.8	41.472N	141.488E	HOKKAIDO JAPAN	33	4.9	4.4	PDE	EQ	ABD	18:55-19:10	16	20025/ 15
0490	83	01	04	004	03:09:03.3	3.155S	101.264E	SOUTHERN SUMATERA	56	5.5	0.0	PDE	EQ	A	03:15-03:26	12	20025/ 16
0491	83	01	04	004	07:03:10.0	42.174N	142.975E	HOKKAIDO JAPAN REGION	36	5.2	0.0	PDE	EQ	ABDE	07:04-07:49	46	20025/ 17
0492	83	01	05	005	01:44:16.5	6.739N	126.924E	MINDANAO PHILIPPINE ISLANDS	105	5.1	0.0	PDE	EQ	A	01:47-01:58	12	0/ 00
0493	83	01	05	005	02:01:03.3	54.748N	162.936E	NEAR EAST COAST OF KAMCHATKA	33	5.6	5.6	PDE	EQ	ABDE	02:03-02:53	51	0/ 00
0494	83	01	05	005	04:28:10.2	9.660N	122.201E	NEGROS PHILIPPINE ISLANDS	33	5.5	5.5	PDE	EQ	A	04:31-04:42	12	0/ 00
0495	83	01	05	005	07:18:35.4	42.321N	142.631E	HOKKAIDO JAPAN REGION	41	5.1	0.0	PDE	EQ	ABDE	07:20-08:04	45	20025/ 18
0496	83	01	05	005	07:38:00.6	9.637N	122.366E	NEGROS PHILIPPINE ISLANDS	33	5.2	0.0	PDE	EQ	A	07:41-07:52	12	20025/ 18
0497	83	01	05	005	16:52:19.9	6.704S	11.741W	ASCENSION ISLAND REGION	10	5.2	4.7	PDE	EQ	A	17:01-17:21	21	20025/ 19
0498	83	01	05	005	16:59:51.2	9.570N	122.265E	NEGROS PHILIPPINE ISLANDS	33	5.0	0.0	PDE	EQ	A	17:03-17:14	12	20025/ 19
0499	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE BONIN ISL. PO,SO,T	0	0.0	0.0	HEL	EQ	BDE	17:41-18:20	40	20025/ 20
0500	83	01	06	006	12:29:50.6	44.503N	148.191E	KURIL ISLANDS	84	5.3	0.0	PDE	EQ	ABDE	12:31-13:14	44	20026/ 01

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT NO	YR	MO	DA	JUL	ORIGIN TIME HR:MN:SECS	LAT	LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	MAGNI SRF	INF SRC	EV TP	PHASES	SAVED INTERVAL	MNS	STRIP TAPE/FILE
0501	83	01	06	006	17:21:26.4	8.349N	147.327E	CAROLINE ISLANDS REGION	33	5.0	0.0	PDE	EQ	ABDE	17:21-17:55	35	20026/ 02
0502	83	01	06	006	18:02:30.0	14.860N	146.997E	MARIANA ISLANDS	33	4.5	0.0	PDE	EQ	ABD	18:02-18:14	13	20026/ 03
0503	83	01	06	006	19:56:44.9	19.668S	176.599W	FIJI ISLANDS REGION	285	5.1	0.0	PDE	EQ	A	19:59-20:10	12	20026/ 04
0504	83	01	06	006	20:29:20.4	31.356N	82.220E	TIBET	33	4.7	0.0	PDE	EQ	A	20:36-20:47	12	20026/ 05
0505	83	01	07	007	09:17:35.6	3.248N	126.857E	TALAUD ISLANDS	63	5.2	0.0	PDE	EQ	A	09:20-09:31	12	20026/ 06
0506	83	01	07	007	18:18:56.9	36.001N	139.747E	HONSHU JAPAN	67	5.0	0.0	PDE	EQ	ABDE	18:20-19:03	44	20026/ 07
0507	83	01	07	007	23:48:24.7	26.863S	176.653W	SOUTH OF FIJI ISLANDS	33	5.3	5.3	PDE	EQ	A	23:52-00:03	12	20026/ 08
0508	83	01	08	008	06:35:12.2	3.316S	177.675E	GILBERT ISLANDS REGION	33	4.9	0.0	PDE	EQ	ABD	06:35-06:50	16	20026/ 09
0509	83	01	08	008	08:10:34.8	17.958S	178.11[illegible]W	FIJI ISLANDS REGION	601	5.1	0.0	PDE	EQ	A	08:12-08:24	13	20026/ 10
0510	83	01	08	008	10:51:33.3	36.423N	70.651E	HINDU KUSH REGION	195	4.8	0.0	PDE	EQ	A	10:59-11:10	12	20026/ 11
0511	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE BONIN ISLANDS	0	0.0	0.0	HEL	EQ	BDE	11:02-11:37	30	20026/ 11
0512	83	01	08	008	11:21:29.6	15.324S	173.397W	TONGA ISLANDS	33	6.1	6.3	PDE	EQ	AE	11:24-12:18	55	20026/ 11
0513	83	01	08	008	15:04:55.2	3.164S	148.255E	BISMARCK SEA	9	5.5	6.1	PDE	EQ	AE	15:06-15:46	43	20026/ 12
0514	83	01	08	008	16:21:14.2	55.265N	163.102E	OFF EAST COAST OF KAMCHATKA	33	5.0	0.0	PDE	EQ	ABDE	16:23-17:13	51	20026/ 13
0515	83	01	09	009	10:42:47.3	55.057N	163.225E	OFF EAST COAST OF KAMCHATKA	33	5.2	5.1	PDE	EQ	ABDE	10:45-11:35	51	20026/ 14
0516	83	01	09	009	12:44:07.3	43.929N	142.687E	HOKKAIDO JAPAN REGION	201	4.7	0.0	PDE	EQ	ABDE	12:45-13:31	47	20027/ 01
0517	83	01	09	009	18:36:53.5	35.922N	139.565E	NEAR S. COAST OF HONSHU JAPAN	100	5.0	0.0	PDE	EQ	ABDE	18:38-19:21	44	20027/ 02
0518	83	01	09	009	21:03:54.0	55.111N	163.381E	OFF EAST COAST OF KAMCHATKA	33	5.4	6.0	PDE	EQ	ABDE	21:06-21:56	51	20027/ 03
0519	83	01	10	010	01:57:55.7	1.944S	133.740E	WEST IRIAN REGION	33	5.3	5.7	PDE	EQ	ABDE	02:00-02:52	53	20027/ 04
0520	83	01	10	010	05:12:51.8	9.628N	122.087E	NEGROS PHILIPPINE ISLANDS	42	5.1	0.0	PDE	EQ	A	05:16-05:27	12	20027/ 05
0521	83	01	10	010	12:32:21.9	27.299S	63.390W	SANTIAGO DEL ESTERO PROV. ARGE	559	5.8	0.0	PDE	EQ	A	12:41-13:01	21	20027/ 06
0522	83	01	11	011	06:12:43.4	3.417S	177.640E	GILBERT ISLANDS REGION	33	4.9	0.0	PDE	EQ	ABD	06:13-06:27	15	20027/ 07
0523	83	01	11	011	18:49:00.0	3.365N	122.338E	CELEBES SEA	642	5.2	0.0	PDE	EQ	A	18:51-19:03	13	20027/ 08
0524	83	01	12	012	01:02:28.5	3.417S	177.597E	GILBERT ISLANDS REGION	33	4.7	0.0	PDE	EQ	ABD	01:03-01:17	15	20027/ 09
0525	83	01	12	012	03:28:25.0	27.031N	96.962E	BURMA-INDIA BORDER REGION	36	4.9	0.0	PDE	EQ	A	03:34-03:45	12	20027/ 10
0526	83	01	12	012	04:29:45.7	56.900N	162.401E	NEAR EAST COAST OF KAMCHATKA	33	4.7	0.0	PDE	EQ	ABD	04:32-04:49	18	20027/ 11
0527	83	01	12	012	09:51:50.0	24.401S	175.824W	SOUTH OF TONGA ISLANDS	33	5.3	5.1	PDE	EQ	A	09:55-10:06	12	20027/ 12
0528	83	01	12	012	12:22:25.6	26.848N	96.794E	BURMA	33	4.6	0.0	PDE	EQ	A	12:28-12:39	12	20027/ 13
0529	83	01	12	012	16:18:32.9	4.357S	150.248E	NEW BRITAIN REGION	567	4.7	0.0	PDE	EQ	ABDE	16:19-17:01	43	20027/ 14
0530	83	01	12	012	16:41:21.8	54.924N	162.869E	NEAR EAST COAST OF KAMCHATKA	33	4.9	0.0	PDE	EQ	ABD	16:43-17:00	18	20027/ 14
0531	83	01	13	013	09:23:47.5	35.780S	102.832W	SOUTHERN PACIFIC OCEAN	10	5.4	5.1	PDE	EQ	ABD	09:33-10:08	35	20027/ 15
0532	83	01	13	013	15:05:05.3	44.458N	148.150E	KURIL ISLANDS	33	5.1	0.0	PDE	EQ	ABDE	15:06-15:49	44	20027/ 16
0533	83	01	13	013	16:30:33.9	6.590S	154.157E	SOLOMON ISLANDS	33	4.8	0.0	PDE	EQ	ABD	16:31-16:46	16	20028/ 01
0534	83	01	14	014	18:20:53.3	56.054N	154.239W	KODIAK ISLAND REGION	33	5.6	5.9	PDE	EQ	ABDE	18:24-19:26	63	20028/ 02
0535	83	01	15	015	00:16:51.3	7.402N	124.592E	MINDANAO PHILIPPINE ISLANDS	35	5.6	4.6	PDE	EQ	A	00:20-00:31	12	20028/ 03
0536	83	01	15	015	02:39:32.3	33.264N	135.974E	NEAR S. COAST OF SOUTH. HONSHU	413	5.5	0.0	PDE	EQ	ABDE	00:40-01:25	46	20028/ 04
0537	83	01	15	015	02:49:54.3	52.839N	160.154E	OFF EAST COAST OF KAMCHATKA	33	5.6	0.0	PDE	EQ	ABDE	00:51-01:40	50	20028/ 04
0538	83	01	15	015	02:20:10.0	6.296S	131.117E	TANIMBAR ISLANDS REGION	46	5.3	0.0	PDE	EQ	A	02:23-02:34	12	20028/ 05
0539	83	01	15	015	16:55:30.6	2.742N	124.202E	CELEBES SEA	375	4.9	0.0	PDE	EQ	A	16:58-17:09	12	20028/ 06
0540	83	01	15	015	19:40:08.1	9.117S	124.157E	TIMOR	92	4.9	0.0	PDE	EQ	A	19:44-19:55	12	20028/ 07
0541	83	01	16	016	02:27:52.1	7.221S	129.491E	BANDA SEA	186	5.2	0.0	PDE	EQ	A	02:31-02:42	12	20028/ 08
0542	83	01	16	016	13:10:44.5	17.203S	176.929W	FIJI ISLANDS REGION	33	5.7	5.3	PDE	EQ	A	13:13-13:24	12	20028/ 09
0543	83	01	16	016	22:10:11.6	5.449S	147.055E	EAST PAPUA NEW GUINEA REGION	229	6.0	0.0	PDE	EQ	ABDE	22:11-22:56	46	20028/ 10
0544	83	01	17	017	09:40:16.0	5.405S	146.525E	EAST PAPUA NEW GUINEA REGION	174	5.4	0.0	PDE	EQ	ABDE	09:41-10:26	46	20028/ 11
0545	83	01	17	017	11:55:30.4	26.427N	126.241E	RYUKYU ISLANDS	33	5.1	0.0	PDE	EQ	A	11:57-12:09	13	20028/ 12
0546	83	01	17	017	12:41:29.3	38.092N	20.193E	GREECE	9	6.0	7.0	PDE	EQ	AF	12:45-14:44	120	20028/ 13
0547	83	01	17	017	19:06:08.3	25.666N	126.219E	RYUKYU ISLANDS	74	4.9	0.0	PDE	EQ	A	19:08-19:19	12	20028/ 14
0548	83	01	18	018	02:22:54.7	49.636S	114.920W	EASTER ISLAND CORDILLERA	10	5.1	5.3	PDE	EQ	ABD	02:31-03:05	35	20029/ 01
0549	83	01	18	018	15:23:33.8	58.023S	24.274W	SOUTH SANDWICH ISLANDS REGION	33	6.0	6.5	PDE	EQ	AF	15:20-17:27	120	20029/ 02
0550	83	01	18	018	17:42:04.2	6.812S	128.107E	BANDA SEA	310	5.0	0.0	PDE	EQ	A	17:45-17:56	12	20029/ 03
0551	83	01	18	018	22:51:56.3	36.368N	70.446E	HINDU KUSH REGION	288	4.4	0.0	PDE	EQ	A	22:59-23:10	12	20029/ 04
0552	83	01	19	019	11:50:10.3	10.618S	166.142E	SANTA CRUZ ISLANDS	153	5.0	0.0	PDE	EQ	ABDE	11:51-12:35	45	20029/ 05
0553	83	01	19	019	12:09:39.1	25.253N	91.853E	INDIA-BANGLADESH BORDER REGION	33	4.9	0.0	PDE	EQ	A	12:16-12:27	12	20029/ 05
0554	83	01	19	019	13:38:29.0	55.895N	160.762E	KAMCHATKA	50	5.0	0.0	PDE	EQ	ABDE	13:40-14:32	53	20029/ 06
0555	83	01	19	019	20:22:06.9	5.741S	154.370E	SOLOMON ISLANDS	112	5.4	0.0	PDE	EQ	ABDE	20:23-21:04	42	20029/ 07
0556	83	01	20	020	10:02:47.6	7.516S	128.848E	BANDA SEA	153	5.0	0.0	PDE	EQ	A	10:06-10:17	12	20029/ 08
0557	83	01	20	020	12:45:32.2	28.754N	142.379E	BONIN ISLANDS REGION	33	5.0	0.0	PDE	EQ	ABDE	12:46-13:23	38	20029/ 09
0558	83	01	20	020	22:22:27.6	51.362N	178.755W	ANDREANOF ISL., ALEUTIAN ISL.	69	4.5	0.0	PDE	EQ	ABD	22:24-22:40	17	20029/ 10
0559	83	01	21	021	05:04:42.8	4.263N	124.559E	CELEBES SEA	306	4.7	0.0	PDE	EQ	A	05:07-05:18	12	20029/ 11
0560	83	01	21	021	10:25:53.1	42.462N	143.034E	HOKKAIDO JAPAN REGION	72	5.2	0.0	PDE	EQ	ABDE	10:27-11:12	46	20029/ 12
0561	83	01	21	021	14:20:06.5	3.400S	141.274E	PAPUA NEW GUINEA	33	5.4	5.2	PDE	EQ	ABDE	14:22-15:09	46	20030/ 01
0562	83	01	21	021	18:01:06.8	3.556S	177.682E	GILBERT ISLANDS REGION	33	5.1	4.8	PDE	EQ	ABDE	18:01-18:40	40	20030/ 02
0563	83	01	22	022	01:24:33.9	6.654S	103.000E	SOUTHWEST OF SUMATERA	33	5.4	5.5	PDE	EQ	A	01:30-01:42	13	20030/ 03
0564	83	01	22	022	01:27:43.4	6.705S	103.013E	SOUTHWEST OF SUMATERA	33	5.4	0.0	PDE	EQ	A	01:34-01:45	12	20030/ 03
0565	83	01	22	022	06:44:36.5	6.753S	102.993E	SOUTHWEST OF SUMATERA	29	5.6	6.1	PDE	EQ	AF	06:48-08:17	90	20030/ 04
0566	83	01	22	022	06:56:25.2	6.875S	103.061E	SOUTHWEST OF SUMATERA	33	5.2	0.0	PDE	EQ	A	07:02-07:13	12	20030/ 04
0567	83	01	22	022	08:44:21.5	26.299S	178.745E	SOUTH OF FIJI ISLANDS	594	5.0	0.0	PDE	EQ	A	08:47-08:58	12	20030/ 05
0568	83	01	23	023	04:31:36.9	11.584N	141.730E	WEST CAROLINE ISLANDS	33	4.9	0.0	PDE	EQ	ABDE	04:32-05:09	38	20030/ 06
0569	83	01	23	023	03:08:36.6	46.319N	152.016E	KURIL ISLANDS	162	4.8	0.0	PDE	EQ	ABDE	08:09-08:54	46	20030/ 07
0570	83	01	23	023	10:46:53.7	2.838N	128.507E	HALMAHERA	33	5.0	0.0	PDE	EQ	A	10:49-11:01	13	20030/ 08
0571	83	01	23	023	16:36:38.7	37.277S	95.243W	SOUTHERN PACIFIC OCEAN	10	5.6	0.0	PDE	EQ	ABD	16:46-17:23	38	20030/ 09
0572	83	01	23	023	17:01:31.9	37.161S	95.147W	SOUTHERN PACIFIC OCEAN	10	5.1	0.0	PDE	EQ	ABD	17:10-17:48	39	20030/ 09
0573	83	01	24	024	08:17:38.6	16.184N	95.149W	OAXACA MEXICO	45	6.3	6.6	PDE	EQ	AE	08:26-10:18	113	20031/ 01
0574	00	00	00	000	02:00:00.0	0.000N	0.000E	POSSIBLE NUCLEAR TEST	0	0.0	0.0	HEL	NX	AE	08:45-09:05	25	20031/ 01
0575	83	01	24	024	13:02:37.1	51.342N	176.308E	RAT ISL., ALEUTIAN ISL.	33	5.4	5.7	PDE	EQ	ABDE	13:04-13:51	48	20031/ 02
0576	83	01	24	024	15:04:16.3	54.664N	160.435E	NEAR EAST COAST OF KAMCHATKA	33	4.7	0.0	PDE	EQ	ABDE	15:06-15:56	51	20031/ 03
0577	83	01	24	024	16:13:21.7	51.433N	176.262E	RAT ISL., ALEUTIAN ISL.	33	4.9	0.0	PDE	EQ	ABD	16:15-16:31	17	20031/ 04
0578	83	01	24	024	16:35:03.4	29.406N	142.014E	SOUTH OF HONSHU JAPAN	33	5.1	0.0	PDE	EQ	ABDE	16:35-17:13	39	20031/ 05
0579	83	01	24	024	23:09:21.5	12.952N	93.640E	ANDAMAN ISLANDS REGION	79	6.1	0.0	PDE	EQ	A	23:15-23:27	13	20031/ 06
0580	83	01	25	025	00:20:29.9	33.672N	141.027E	OFF EAST COAST OF HONSHU JAPAN	64	4.9	0.0	PDE	EQ	ABD	00:29-00:44	16	20031/ 07
0581	83	01	25	025	03:32:07.3	9.676S	161.123E	SOLOMON ISLANDS	92	4.6	0.0	PDE	EQ	ABD	03:33-03:48	16	20031/ 08
0582	83	01	25	025	06:00:09.0	3.618S	140.223E	WEST IRIAN	33	5.4	5.8	PDE	EQ	A	06:10-06:21	12	20031/ 09
0583	83	01	25	025	07:24:45.5	3.491S	140.269E	WEST IRIAN	33	5.3	0.0	PDE	EQ	A	07:26-07:38	13	20031/ 10
0584	83	01	25	025	07:34:48.6	45.711N	26.614E	ROMANIA	164	4.7	0.0	PDE	EQ	A	07:44-08:03	20	20031/ 11
0585	83	01	25	025	11:20:21.5	51.483N	176.320E	RAT ISL., ALEUTIAN ISL.	33	5.1	4.5	PDE	EQ	ABDE	11:30-12:17	46	20031/ 12
0586	83	01	25	025	16:42:09.4	3.454S	140.342E	WEST IRIAN	33	5.1	0.0	PDE	EQ	A	16:44-16:55	12	20031/ 13
0587	83	01	25	025	20:06:37.0	36.394N	70.888E	HINDU KUSH REGION	182	5.0	0.0	PDE	EQ	A	20:14-20:25	12	20031/ 14
0588	83	01	26	026	04:40:12.5	49.707S	114.073W	EASTER ISLAND CORDILLERA	10	5.1	0.0	PDE	EQ	ABD	04:49-05:23	35	20032/ 01
0589	83	01	26	026	04:43:18.7	49.751S	115.119W	EASTER ISLAND CORDILLERA	10	5.7	6.1	PDE	EQ	ABD	04:52-05:26	35	20032/ 01
0590	83	01	26	026	16:02:21.5	30.355S	179.427W	KERMADEC ISLANDS REGION	238	6.1	0.0	PDE	EQ	A	16:06-16:17	12	20032/ 02
0591	83	01	26	026	17:52:39.2	6.132S	150.052E	NEW BRITAIN REGION	47	5.7	0.0	PDE	EQ	ABDE	17:54-18:37	44	20032/ 03
0592	83	01	26	026	18:55:56.7	15.255S	173.416W	TONGA ISLANDS	33	5.4	0.0	PDE	EQ	A	18:58-19:10	13	20032/ 04
0593	83	01	26	026	20:23:30.7	7.234S	155.985E	SOLOMON ISLANDS	71	5.5	0.0	PDE	EQ	ABDE	20:24-21:06	43	20032/ 05
0594	83	01	27	027	04:05:09.2	44.572N	148.181E	KURIL ISLANDS	34	5.0	0.0	PDE	EQ	ABDE	04:06-04:50	45	20032/ 06
0595	83	01	27	027	09:07:33.1	35.715N	139.439E	NEAR S. COAST OF HONSHU JAPAN	77	4.8	0.0	PDE	EQ	ABD	09:08-09:24	17	20032/ 07
0596	83	01	27	027	09:42:39.2	35.570N	139.774E	NEAR S. COAST OF HONSHU JAPAN	33	4.6	0.0	PDE	EQ	ABD	09:43-09:59	17	20032/ 08
0597	83	01	27	027	16:36:47.2	6.975S	129.521E	BANDA SEA	166	5.1	0.0	PDE	EQ	A	16:40-16:51	12	20032/ 09
0598	83	01	28	028	03:15:10.1	2.604N	124.130E	CELEBES SEA	362	5.6	0.0	PDE	EQ	A	03:18-03:29	12	20032/ 10
0599	83	01	28	028	08:38:43.3	36.617N	94.772E	QINGHAI PROVINCE CHINA	33	4.8	0.0	PDE	EQ	A	08:44-08:55	12	20032/ 11
0600	83	01	28	028	11:17:32.0	10.325S	168.911E	VANUATU ISLANDS	214	4.8	0.0	PDE	EQ	A	11:19-11:31	13	20032/ 12

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 5 JUL 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT	ORIGIN TIME					COORDINATES		LOCATION	DEP	MAGNI		INF	EV	SAVED			STRIP
NO	YR	MO	DA	JUL	HR:MN:SECS	LAT	LON	DESCRIPTION	KM	BDY	SRF	SRC	TP	PHASES	INTERVAL	MNS	TAPE/FILE
0601	83	01	20	020	14:23:05.4	10.740S	165.813E	SANTA CRUZ ISLANDS	79	5.6	0.0	PDE	EQ	ABDE	14:24-15:00	45	20032/ 13
0602	83	01	20	020	15:05:34.9	20.735N	139.318E	BONIN ISLANDS REGION	443	5.1	0.0	PDE	EQ	ABDE	15:06-15:46	41	20032/ 13
0603	83	01	20	020	21:01:37.3	3.030S	177.857E	GILBERT ISLANDS REGION	33	4.9	0.0	PDE	EQ	ABD	21:02-21:16	15	20032/ 14
0604	83	01	29	029	00:07:01.0	17.613S	179.869E	FIJI ISLANDS	634	4.8	0.0	PDE	EQ	A	00:08-00:20	13	20032/ 15
0605	83	01	29	029	02:44:10.2	36.585N	141.400E	NEAR E. COAST OF HONSHU JAPAN	58	5.0	0.0	PDE	EQ	ABDE	02:45-03:27	43	20032/ 16
0606	83	01	29	029	09:54:57.2	48.214N	146.151E	SEA OF OKHOTSK	480	4.8	0.0	PDE	EQ	ABDE	09:56-10:44	49	20033/ 01
0607	83	01	29	029	10:02:14.7	48.214N	146.177E	SEA OF OKHOTSK	478	4.9	0.0	PDE	EQ	ABDE	10:03-10:51	49	20033/ 01
0608	83	01	29	029	17:47:52.4	17.515S	179.886E	FIJI ISLANDS	630	4.8	0.0	PDE	EQ	A	17:49-18:01	13	20033/ 02
0609	83	01	30	030	01:26:05.9	5.420N	94.942E	NORTHERN SUMATERA	82	5.2	0.0	PDE	EQ	A	01:32-01:43	12	20033/ 03
0610	83	01	30	030	13:29:54.2	10.350S	161.231E	SOLOMON ISLANDS	98	4.8	0.0	PDE	EQ	ABD	13:31-13:46	16	20033/ 04
0611	83	01	30	030	22:45:39.9	33.369N	140.796E	SOUTH OF HONSHU JAPAN	49	5.7	5.1	PDE	EQ	ABDE	22:46-23:27	42	20033/ 05
0612	83	01	31	031	05:32:21.1	7.397S	128.743E	BANDA SEA	103	5.3	0.0	PDE	EQ	A	05:35-05:47	13	20033/ 05
0613	83	01	31	031	21:17:31.4	3.390S	177.616E	GILBERT ISLANDS REGION	29	5.8	5.3	PDE	EQ	ABDE	21:18-21:56	39	20033/ 07
0614	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO, SO, T	0	0.0	0.0	HEL	EQ	BDE	22:23-22:52	30	20033/ 08
0615	83	02	01	032	02:07:07.7	3.486S	140.147E	WEST IRIAN	33	5.1	0.0	PDE	EQ	ABDE	02:09-02:57	49	20033/ 09
0616	83	02	01	032	14:47:28.4	37.156N	135.000E	SEA OF JAPAN	374	4.2	0.0	PDE	EQ	ABDE	14:48-15:36	49	20033/ 10
0617	83	02	01	032	15:38:06.8	4.675S	144.042E	NEAR N COAST OF PAPUA NEW GUIN	68	5.3	0.0	PDE	EQ	ABDE	15:40-16:25	46	20033/ 11
0618	83	02	02	033	20:44:06.1	27.032N	92.870E	INDIA-CHINA BORDER REGION	33	5.2	0.0	PDE	EQ	A	20:50-21:01	12	20033/ 12
0619	83	02	04	035	06:31:16.3	1.513N	127.259E	HALMAHERA	150	5.4	0.0	PDE	EQ	A	06:34-06:45	12	20033/ 13
0620	83	02	04	035	15:21:57.8	4.386S	152.840E	NEW BRITAIN REGION	43	5.4	0.0	PDE	EQ	ABDE	15:23-16:03	41	20033/ 14
0621	83	02	04	035	19:05:59.6	10.393S	124.304E	TIMOR	33	5.4	0.0	PDE	EQ	A	19:10-19:21	12	20033/ 15
0622	83	02	05	036	03:51:58.0	5.584S	153.019E	NEW IRELAND REGION	47	5.0	0.0	PDE	EQ	ABDE	03:53-04:34	42	20034/ 01
0623	83	02	05	036	15:47:19.6	6.525S	154.865E	SOLOMON ISLANDS	51	5.0	0.0	PDE	EQ	ABDE	15:48-16:30	43	20034/ 02
0624	83	02	05	036	17:07:53.1	3.375S	177.567E	GILBERT ISLANDS REGION	33	5.1	0.0	PDE	EQ	ABDE	17:08-17:46	39	20034/ 03
0625	83	02	05	036	23:51:46.1	3.369S	177.670E	GILBERT ISLANDS REGION	33	5.8	5.6	PDE	EQ	ABDE	23:52-00:30	39	0/ 00
0626	83	02	06	037	01:52:33.5	36.187N	68.997E	HINDU KUSH REGION	89	5.1	0.0	PDE	EQ	A	02:00-02:11	12	0/ 00
0627	83	02	06	037	16:15:29.6	3.314S	177.866E	GILBERT ISLANDS REGION	33	4.8	0.0	PDE	EQ	ABD	16:16-16:30	15	0/ 00
0628	83	02	07	038	01:21:02.8	10.291S	161.063E	SOLOMON ISLANDS	89	5.3	0.0	PDE	EQ	ABDE	01:22-02:06	45	0/ 00
0629	83	02	07	038	11:07:26.9	26.495S	177.799W	SOUTH OF FIJI ISLANDS	181	5.3	0.0	PDE	EQ	A	11:11-11:22	12	20034/ 04
0630	83	02	07	038	16:53:30.3	49.331N	155.627E	KURIL ISLANDS	33	5.2	4.6	PDE	EQ	ABDE	16:55-17:40	46	20034/ 05
0631	83	02	07	038	16:56:33.8	7.041S	129.005E	BANDA SEA	180	5.0	0.0	PDE	EQ	A	17:00-17:11	12	20034/ 05
0632	00	02	00	002	03:00:00.0	0.000N	0.000E	POSSIBLE NUCLEAR TEST	0	0.0	0.0	HEL	NX	A	17:59-18:13	15	20034/ 06
0633	83	02	07	038	18:23:54.2	29.780S	178.464W	KERMADEC ISLANDS	403	5.7	0.0	PDE	EQ	A	18:27-18:38	12	20034/ 07
0634	83	02	07	038	21:26:00.0	33.710N	135.939E	NEAR S. COAST OF S. HONSHU	406	4.8	0.0	PDE	EQ	ABDE	21:27-22:12	46	20034/ 08
0635	83	02	08	039	00:51:19.5	26.426N	126.156E	RYUKYU ISLANDS	135	4.5	0.0	PDE	EQ	A	00:53-01:05	13	20034/ 09
0636	83	02	08	039	02:02:46.0	19.350N	155.233W	HAWAII	27	4.7	0.0	PDE	EQ	ABDE	02:05-02:54	50	20034/ 10
0637	83	02	08	039	06:58:42.9	51.675N	159.752E	OFF EAST COAST OF KAMCHATKA	33	5.7	5.6	PDE	EQ	ABDE	07:00-07:47	48	20034/ 11
0638	83	02	08	039	10:19:50.9	6.352S	147.627E	EAST PAPUA NEW GUINEA REGION	59	5.3	0.0	PDE	EQ	ABDE	10:21-11:06	46	20034/ 12
0639	83	02	08	039	14:06:19.2	45.926N	143.962E	HOKKAIDO JAPAN REGION	252	5.2	0.0	PDE	EQ	ABDE	14:07-14:54	48	20034/ 13
0640	83	02	08	039	16:17:47.9	1.675S	96.473E	SOUTHWEST OF SUMATERA	15	5.3	0.0	PDE	EQ	A	16:24-16:35	12	20035/ 01
0641	83	02	08	039	21:30:52.1	20.403S	177.867W	FIJI ISLANDS REGION	643	5.0	0.0	PDE	EQ	A	21:33-21:44	12	20035/ 02
0642	83	02	09	040	05:43:36.0	19.546N	120.468E	PHILIPPINE ISLANDS REGION	33	5.4	0.0	PDE	EQ	A	05:47-05:58	12	20035/ 03
0643	83	02	09	040	05:54:00.9	19.569N	120.535E	PHILIPPINE ISLANDS REGION	33	5.4	5.4	PDE	EQ	A	05:57-06:08	12	20035/ 03
0644	83	02	09	042	07:02:31.6	7.592S	156.070E	SOLOMON ISLANDS	36	5.6	5.7	PDE	EQ	ABDE	07:03-07:45	43	20035/ 04
0645	83	02	09	040	13:31:34.1	19.534N	120.438E	PHILIPPINE ISLANDS REGION	33	5.1	0.0	PDE	EQ	A	13:34-13:46	13	20035/ 05
0646	00	00	00	000	02:00:00.0	0.000N	0.000E	PROBABLE BONIN ISLANDS	0	0.0	0.0	HEL	EQ	BDE	14:01-14:30	30	20035/ 06
0647	83	02	11	042	01:33:01.8	49.875N	153.933E	KURIL ISLANDS	177	4.7	0.0	PDE	EQ	ABDE	01:34-02:21	48	20035/ 07
0648	83	02	11	042	04:34:18.2	5.741S	133.762E	AROE ISLANDS REGION	33	5.6	4.5	PDE	EQ	A	04:37-04:48	12	20035/ 08
0649	83	02	11	042	16:00:00.1	37.051N	116.045W	SOUTHERN NEVADA	0	0.0	0.0	PDE	NX	A	16:06-16:17	12	20035/ 09
0650	83	02	11	042	17:41:02.7	20.784S	178.283W	FIJI ISLANDS REGION	513	5.1	0.0	PDE	EQ	A	17:43-17:54	12	20035/ 10
0651	83	02	12	043	05:17:10.7	36.390N	71.053E	AFGHANISTAN-USSR BORDER REGION	270	4.6	0.0	PDE	EQ	A	05:24-05:35	12	20035/ 11
0652	83	02	12	043	08:47:10.8	5.610N	126.444E	MINDANAO PHILIPPINE ISLANDS	38	5.8	6.0	PDE	EQ	AE	08:50-09:45	56	20035/ 12
0653	83	02	12	043	11:20:07.1	5.520N	125.555E	MINDANAO PHILIPPINE ISLANDS	33	5.0	0.0	PDE	EQ	A	11:31-11:42	12	20035/ 13
0654	83	02	12	043	22:58:24.5	23.709N	105.086E	YUNNAN PROVINCE CHINA	33	4.6	0.0	PDE	EQ	A	23:03-23:14	12	20035/ 14
0655	83	02	13	044	01:40:13.2	39.988N	75.097E	SOUTHERN SINKIANG PROV CHINA	33	5.6	6.2	PDE	EQ	AE	01:47-03:26	100	20035/ 15
0656	83	02	13	044	01:52:52.2	39.992N	75.275E	SOUTHERN SINKIANG PROV CHINA	33	5.2	0.0	PDE	EQ	A	02:00-02:11	12	20035/ 15
0657	83	02	13	044	02:39:03.3	39.916N	75.260E	SOUTHERN SINKIANG PROV CHINA	33	4.4	0.0	PDE	EQ	A	02:46-02:57	12	20035/ 15
0658	83	02	13	044	04:18:52.9	39.962N	75.120E	SOUTHERN SINKIANG PROV CHINA	33	4.5	0.0	PDE	EQ	A	04:26-04:37	12	20035/ 16
0659	83	02	13	044	06:35:30.0	13.836N	144.977E	MARIANA ISLANDS	109	5.6	0.0	PDE	EQ	ABDE	06:35-07:09	35	20035/ 17
0660	83	02	13	044	07:23:11.8	40.055N	75.137E	KIRGHIZ-SINKIANG BORDER REGION	33	4.9	0.0	PDE	EQ	A	07:30-07:41	12	20036/ 01
0661	83	02	13	044	14:23:01.1	5.520N	126.521E	MINDANAO PHILIPPINE ISLANDS	33	5.0	4.9	PDE	EQ	A	14:26-14:37	12	20036/ 02
0662	83	02	13	044	15:10:12.1	11.410N	126.215E	PHILIPPINE ISLANDS REGION	33	5.1	0.0	PDE	EQ	A	15:13-15:24	12	20036/ 03
0663	83	02	14	045	00:23:10.6	10.479N	140.934E	WEST CAROLINE ISLANDS	33	5.8	5.8	PDE	EQ	ABDE	00:24-01:02	39	20036/ 04
0664	83	02	14	045	01:29:52.3	1.640N	126.409E	MOLUCCA PASSAGE	56	5.2	0.0	PDE	EQ	A	01:33-01:44	12	20036/ 05
0665	83	02	14	045	03:20:03.3	54.956N	159.191W	SOUTH OF ALASKA	33	5.9	6.3	PDE	EQ	AE	03:23-04:21	59	20036/ 06
0666	83	02	14	045	06:00:01.3	22.412S	169.766E	LOYALTY ISLANDS REGION	75	5.0	0.0	PDE	EQ	A	06:11-06:22	12	20036/ 07
0667	83	02	14	045	08:10:03.7	54.971N	159.212W	SOUTH OF ALASKA	33	5.9	5.6	PDE	EQ	AE	08:13-09:11	59	20036/ 08
0668	83	02	14	045	23:48:12.8	51.804N	175.571E	RAT ISLANDS, ALEUTIAN ISLANDS	91	4.6	0.0	PDE	EQ	ABD	23:50-00:06	17	20036/ 09
0669	83	02	15	046	01:14:35.4	10.236S	161.388E	SOLOMON ISLANDS	78	5.2	0.0	PDE	EQ	ABDE	01:15-01:59	45	20036/ 10
0670	83	02	16	047	09:50:35.3	25.329S	179.624E	SOUTH OF FIJI ISLANDS	470	5.4	0.0	PDE	EQ	A	09:53-10:04	12	20036/ 11
0671	83	02	17	048	00:16:01.0	43.939N	83.818E	NORTHERN SINKIANG PROV CHINA	33	5.1	0.0	PDE	EQ	A	00:22-00:34	13	20036/ 12
0672	00	00	00	000	02:00:00.0	0.000N	0.000E	PROBABLE BONIN ISL. PO SO T	0	0.0	0.0	HEL	EQ	BDE	15:20-15:54	35	20036/ 13
0673	83	02	17	048	16:10:40.7	21.378S	174.469W	TONGA ISLANDS	41	5.9	5.6	PDE	EQ	A	16:14-16:25	12	20036/ 14
0674	83	02	17	048	17:00:00.0	37.163N	116.063W	SOUTHERN NEVADA	0	4.0	0.0	PDE	NX	A	17:06-17:17	12	20036/ 15
0675	83	02	18	049	03:53:37.6	23.068N	143.959E	VOLCANO ISLANDS REGION	33	4.9	0.0	PDE	EQ	ABD	03:53-04:07	15	20036/ 16
0676	83	02	18	049	14:51:20.9	7.307N	125.185E	MINDANAO PHILIPPINE ISLANDS	33	5.3	0.0	PDE	EQ	A	14:54-15:05	12	20036/ 17
0677	00	00	00	000	00:00:00.0	0.000N	0.000E	POSSIBLE NUCLEAR TEST	0	0.0	0.0	HEL	NX	A	14:54-15:08	15	20036/ 17
0678	83	02	18	049	19:31:34.9	5.055S	153.242E	NEW IRELAND REGION	33	5.2	0.0	PDE	EQ	ABDE	19:32-20:13	42	20036/ 18
0679	83	02	19	050	15:57:19.2	24.053N	122.629E	TAIWAN REGION	33	5.1	4.6	PDE	EQ	A	16:00-16:11	12	20036/ 19
0680	83	02	19	050	20:14:22.6	8.718N	124.023E	MINDANAO PHILIPPINE ISLANDS	564	5.8	0.0	PDE	EQ	A	20:16-20:28	13	20036/ 20
0681	83	02	19	050	21:40:39.9	4.507S	137.005E	WEST IRIAN	81	4.8	0.0	PDE	EQ	ABD	21:43-22:00	18	20037/ 01
0682	83	02	20	051	01:21:35.6	43.448N	147.433E	KURIL ISLANDS	33	5.0	0.0	PDE	EQ	ABDE	01:22-02:05	44	20037/ 02
0683	83	02	20	051	02:26:51.5	12.881N	92.966E	ANDAMAN ISLANDS REGION	38	5.2	4.4	PDE	EQ	A	02:33-02:44	12	20037/ 03
0684	83	02	20	051	04:49:02.7	9.670S	100.156E	SOUTH OF JAVA	33	5.0	0.0	PDE	EQ	A	04:55-05:06	12	20037/ 04
0685	83	02	20	051	08:19:25.9	11.511S	118.337E	SOUTH OF SUMBAWA ISLAND	33	4.8	0.0	PDE	EQ	A	08:24-08:35	12	20037/ 05
0686	83	02	20	051	10:49:54.5	5.527N	126.316E	MINDANAO PHILIPPINE ISLANDS	67	6.0	0.0	PDE	EQ	A	10:53-11:04	12	20037/ 06
0687	83	02	20	051	11:34:54.7	5.538N	126.632E	MINDANAO PHILIPPINE ISLANDS	33	5.0	0.0	PDE	EQ	A	11:38-11:49	12	20037/ 07
0688	83	02	20	051	13:56:01.8	5.550N	126.506E	MINDANAO PHILIPPINE ISLANDS	51	5.0	0.0	PDE	EQ	A	13:59-14:10	12	20037/ 08
0689	83	02	20	051	20:46:58.5	12.309N	144.089E	SOUTH OF MARIANA ISLANDS	37	5.2	5.1	PDE	EQ	ABDE	20:47-21:22	36	20037/ 09
0690	83	02	21	052	12:51:04.0	5.591N	126.615E	MINDANAO PHILIPPINE ISLANDS	33	5.1	0.0	PDE	EQ	A	12:54-13:05	12	20037/ 10
0691	83	02	21	052	17:46:24.4	17.768S	172.500W	TONGA ISLANDS REGION	33	5.3	0.0	PDE	EQ	A	17:49-18:00	12	20037/ 11
0692	83	02	21	052	18:26:56.0	45.706N	148.947E	KURIL ISLANDS	33	5.0	0.0	PDE	EQ	ABDE	18:28-19:12	45	20037/ 12
0693	83	02	22	053	02:48:52.3	35.637N	139.917E	NEAR S COAST OF HONSHU JAPAN	84	4.9	0.0	PDE	EQ	ABD	02:50-03:05	16	20037/ 13
0694	83	02	22	053	09:36:44.4	16.041N	95.333W	OAXACA MEXICO	37	5.6	5.1	PDE	EQ	A	09:45-09:56	12	20037/ 14
0695	83	02	22	053	14:49:41.5	17.952S	168.376E	VANUATU ISLANDS	182	5.1	0.0	PDE	EQ	A	14:51-15:03	13	20037/ 15
0696	83	02	22	053	18:43:29.9	29.703N	67.378E	PAKISTAN	33	4.7	0.0	PDE	EQ	A	18:51-19:02	12	20037/ 16
0697	83	02	23	054	14:13:36.5	40.375N	63.626E	UZBEK SSR	33	5.0	4.2	PDE	EQ	A	14:21-14:32	12	20037/ 17
0698	83	02	23	054	21:26:45.0	1.994N	125.663E	MOLUCCA PASSAGE	79	5.3	0.0	PDE	EQ	A	21:30-21:41	12	20037/ 18
0699	83	02	24	055	09:44:56.2	5.297S	103.056E	SOUTHERN SUMATERA	74	4.7	0.0	PDE	EQ	A	09:51-10:02	12	20037/ 19
0700	83	02	24	055	18:23:24.0	23.672S	179.136E	SOUTH OF FIJI ISLANDS	651	5.5	0.0	PDE	EQ	A	18:26-18:37	12	20037/ 20

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 6 JUL 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT NO	YR	MO	DA	JUL	HR:MN:SECS	LAT	LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	MAGNI SRF	INF SRC	EV TP	PHASES	SAVED INTERVAL	MNS	STRIP TAPE/FILE
0701	83	02	25	056	05:16:06.1	23.547S	176.339W	SOUTH OF FIJI ISLANDS	33	5.0	4.6	PDE	EQ	A	05:19-05:31	13	20037/ 21
0702	83	02	25	056	08:37:08.1	35.840N	78.038E	EASTERN KASHMIR	33	4.9	0.0	PDE	EQ	A	08:44-08:55	12	20037/ 22
0703	83	02	25	056	16:33:11.1	7.370S	107.116E	JAVA	90	5.0	0.0	PDE	EQ	A	16:39-16:50	12	20037/ 23
0704	83	02	25	056	22:03:54.9	5.423S	146.826E	EAST PAPUA NEW GUINEA REGION	222	6.0	0.0	PDE	EQ	ABDE	22:05-22:50	46	20037/ 24
0705	83	02	25	056	22:49:52.1	18.757S	69.582W	NORTHERN CHILE	144	5.9	0.0	PDE	EQ	A	22:59-23:18	20	20037/ 25
0706	83	02	26	057	02:05:36.9	22.418N	121.234E	TAIWAN REGION	37	5.1	4.5	PDE	EQ	A	02:08-02:20	13	20037/ 26
0707	83	02	26	057	03:01:26.4	31.931N	131.670E	KYUSHU JAPAN	52	5.2	4.6	PDE	EQ	ABDE	03:03-03:51	49	20038/ 01
0708	83	02	26	057	05:32:04.6	3.217S	136.853E	WEST IRIAN	33	4.0	0.0	PDE	EQ	ABD	05:34-05:51	18	20038/ 02
0709	83	02	26	057	06:01:16.5	18.038S	172.286W	TONGA ISLANDS REGION	33	5.1	0.0	PDE	EQ	A	06:04-06:15	12	20038/ 03
0710	83	02	26	057	07:10:59.2	49.231N	155.617E	KURIL ISLANDS	57	6.0	0.0	PDE	EQ	ABDE	07:12-07:57	46	20038/ 04
0711	83	02	26	057	11:42:40.7	50.524S	162.796E	AUCKLAND ISLANDS REGION	10	5.4	0.0	PDE	EQ	A	11:49-12:00	12	20038/ 05
0712	00	00	00	220	00:00:00.0	0.000N	0.000E	UNKNOWN P PHASE	0	0.0	0.0	HEL	UN	A	16:25-16:34	10	20038/ 06
0713	83	02	26	057	20:07:48.4	38.973N	70.815E	AFGHANISTAN-USSR BORDER REGION	33	5.3	5.1	PDE	EQ	A	20:15-20:26	12	20038/ 07
0714	83	02	27	058	10:11:04.7	36.099N	141.902E	NEAR E COAST OF HONSHU JAPAN	33	4.7	0.0	PDE	EQ	ABD	10:12-10:26	15	20038/ 08
0715	83	02	27	058	12:14:19.1	35.072N	139.948E	NEAR S COAST OF HONSHU JAPAN	64	5.9	0.0	PDE	EQ	ABDE	12:15-12:58	44	20038/ 09
0716	83	02	27	058	20:33:08.5	32.638N	76.567E	KASHMIR-TIBET BORDER REGION	52	5.3	4.9	PDE	EQ	A	20:40-20:51	12	20038/ 10
0717	83	02	28	059	05:44:24.3	44.164N	148.039E	KURIL ISLANDS	41	5.8	5.9	PDE	EQ	ABDE	05:45-06:29	45	20038/ 11
0718	83	02	28	059	09:01:12.0	40.824N	72.153E	KIRGHIZ SSR	33	4.9	0.0	PDE	EQ	A	09:08-09:20	13	20038/ 12
0719	83	02	28	059	18:33:14.3	28.102N	142.219E	BONIN ISLANDS REGION	33	5.0	0.0	PDE	EQ	ABDE	18:33-19:11	39	20038/ 13
0720	83	02	28	059	22:17:58.6	4.009S	142.344E	PAPUA NEW GUINEA	103	5.3	0.0	PDE	EQ	ABDE	22:19-23:07	49	20038/ 14
0721	83	03	01	060	02:02:19.5	39.168N	54.594E	TURKMEN SSR	33	4.8	0.0	PDE	EQ	A	02:11-02:22	12	20038/ 15
0722	83	03	01	060	09:02:17.3	31.066N	141.637E	SOUTH OF HONSHU JAPAN	33	5.0	5.4	PDE	EQ	ABDE	09:03-09:41	39	20038/ 16
0723	83	03	01	060	13:22:31.6	28.610N	95.982E	INDIA-CHINA BORDER REGION	33	5.0	0.0	PDE	EQ	A	13:28-13:39	12	20038/ 17
0724	83	03	01	060	19:26:45.4	5.715S	104.314E	SOUTHERN SUMATERA	33	5.0	0.0	PDE	EQ	A	19:32-19:44	13	20038/ 18
0725	00	02	00	000	02:00:00.0	0.000N	0.000E	PROBABLE MARIANAS	0	0.0	0.0	HEL	EQ	BDE	01:50-02:19	30	20039/ 01
0726	83	03	02	061	07:07:41.4	11.595S	77.827W	NEAR COAST OF PERU	64	5.5	0.0	PDE	EQ	A	07:17-07:36	20	20039/ 02
0727	83	03	02	061	08:11:22.1	37.249N	141.974E	NEAR E COAST OF HONSHU JAPAN	33	4.7	0.0	PDE	EQ	ABD	08:12-08:27	16	20039/ 03
0728	83	03	03	062	01:51:19.5	18.019S	178.206W	FIJI ISLANDS REGION	560	5.2	0.0	PDE	EQ	A	01:53-02:04	12	20039/ 04
0729	83	03	03	062	02:02:21.4	11.433N	139.873E	WEST CAROLINE ISLANDS	45	5.0	0.0	PDE	EQ	ABDE	02:03-02:42	40	20039/ 04
0730	83	03	03	062	02:30:31.0	6.152S	102.783E	SOUTHWEST OF SUMATERA	33	5.6	5.4	PDE	EQ	A	02:37-02:48	12	20039/ 04
0731	83	03	03	062	03:32:13.0	43.928N	85.697E	NORTHERN SINKIANG PROV CHINA	33	5.5	0.0	PDE	EQ	A	03:38-03:50	13	20039/ 05
0732	83	03	03	062	16:42:54.6	41.763N	143.425E	HOKKAIDO JAPAN REGION	33	5.2	0.0	PDE	EQ	ABDE	16:44-17:28	45	20039/ 06
0733	83	03	03	062	17:43:00.4	39.413N	143.373E	OFF E COAST OF HONSHU JAPAN	33	4.9	0.0	PDE	EQ	ABD	17:44-17:59	16	20039/ 07
0734	83	03	04	063	14:11:36.0	39.553N	143.132E	OFF E COAST OF HONSHU JAPAN	33	5.2	5.6	PDE	EQ	ABDE	14:12-14:55	44	20039/ 08
0735	83	03	04	063	19:06:12.9	14.265S	14.319W	SOUTH ATLANTIC RIDGE	10	5.2	5.3	PDE	EQ	ABD	19:15-20:19	65	20039/ 09
0736	00	00	00	000	03:00:00.0	0.000N	0.000E	PROBABLE MARIANAS	0	0.0	0.0	HEL	EQ	BDE	23:50-00:19	30	20039/ 10
0737	83	03	05	064	09:57:04.0	10.794S	115.054E	SOUTH OF BALI ISLAND	33	5.0	5.3	PDE	EQ	A	09:02-09:13	12	20039/ 11
0738	83	03	05	064	11:37:53.6	39.141N	64.586E	UZBEK SSR	33	4.8	0.0	PDE	EQ	A	11:46-11:57	12	20039/ 12
0739	83	03	05	064	16:41:47.1	22.650N	93.971E	BURMA-INDIA BORDER REGION	97	4.6	0.0	PDE	EQ	A	16:47-16:59	13	20039/ 13
0740	83	03	05	064	21:32:20.8	35.575N	136.147E	SOUTHERN HONSHU JAPAN	49	4.8	0.0	PDE	EQ	ABD	21:34-21:49	16	20039/ 14
0741	83	03	05	064	21:50:06.0	49.547N	150.702E	NORTHWEST OF KURIL ISLANDS	347	4.9	0.0	PDE	EQ	ABDE	21:51-22:39	49	20039/ 15
0742	83	03	06	065	22:23:57.7	6.144S	147.308E	EAST PAPUA NEW GUINEA REGION	84	5.5	0.0	PDE	EQ	ABDE	22:25-23:10	46	20040/ 01
0743	83	03	07	066	06:30:26.1	9.561N	126.071E	MINDANAO PHILIPPINE ISLANDS	87	5.0	0.0	PDE	EQ	A	06:33-06:44	12	20040/ 02
0744	83	03	07	066	15:12:22.3	18.297N	146.551E	MARIANA ISLANDS	70	4.8	0.0	PDE	EQ	ABD	15:11-15:24	14	0/ 00
0745	83	03	08	067	13:21:46.8	3.476S	177.631E	GILBERT ISLANDS REGION	33	5.8	5.0	PDE	EQ	ABDE	13:22-14:00	39	20040/ 03
0746	83	03	08	067	18:30:07.7	3.507S	177.707E	GILBERT ISLANDS REGION	33	5.1	0.0	PDE	EQ	ABDE	18:38-19:17	40	20040/ 04
0747	83	03	08	067	20:24:25.2	13.770N	144.747E	MARIANA ISLANDS	108	5.0	0.0	PDE	EQ	ABDE	20:24-20:58	35	20040/ 05
0748	83	03	08	067	23:27:57.5	7.094S	129.261E	BANDA SEA	181	5.4	0.0	PDE	EQ	A	23:31-23:42	12	0/ 00
0749	83	03	09	068	00:05:46.2	7.238S	107.762E	JAVA	118	5.4	0.0	PDE	EQ	A	00:11-00:22	12	0/ 00
0750	83	03	09	068	17:16:27.7	5.058S	145.697E	EAST PAPUA NEW GUINEA REGION	282	5.0	0.0	PDE	EQ	ABDE	17:18-18:03	46	20040/ 06
0751	83	03	10	069	00:27:49.4	43.011N	147.441E	KURIL ISLANDS	42	6.2	5.8	PDE	EQ	ABDE	00:29-01:12	44	20040/-07
0752	83	03	10	069	05:46:06.0	14.645S	167.282E	VANUATU ISLANDS	33	5.3	0.0	PDE	EQ	A	05:48-05:59	12	20040/ 08
0753	83	03	10	069	11:58:19.9	5.411N	126.760E	MINDANAO PHILIPPINE ISLANDS	33	5.4	5.6	PDE	EQ	A	12:01-12:12	12	20040/ 09
0754	83	03	11	070	00:24:09.3	10.249S	13.430W	ASCENSION ISLAND REGION	10	4.8	0.0	PDE	EQ	A	00:33-00:52	20	0/ 00
0755	83	03	11	070	03:10:42.1	6.992S	147.374E	EAST PAPUA NEW GUINEA REGION	66	5.9	0.0	PDE	EQ	ABDE	03:12-03:58	47	0/ 00
0756	83	03	11	070	23:02:36.5	5.372N	126.623E	MINDANAO PHILIPPINE ISLANDS	60	5.2	0.0	PDE	EQ	A	23:05-23:16	12	20042/-10
0757	83	03	12	071	00:44:44.6	36.435N	70.959E	HINDU KUSH REGION	234	4.5	0.0	PDE	EQ	A	00:52-01:03	12	20042/-11
0758	83	03	12	071	00:53:40.2	4.037S	127.914E	BANDA SEA	33	5.9	6.0	PDE	EQ	AE	00:57-01:55	59	20042/-11
0759	83	03	12	071	01:36:36.6	4.103S	127.918E	BANDA SEA	22	6.0	6.5	PDE	EQ	AE	01:40-02:38	59	20042/-11
0760	83	03	12	071	07:00:15.8	52.325N	170.119W	FOX ISL. ALEUTIAN ISL.	33	5.3	5.2	PDE	EQ	ABDE	07:02-07:54	53	20047/ 12
0761	83	03	12	071	07:21:50.2	5.395N	126.671E	MINDANAO PHILIPPINE ISLANDS	63	5.0	0.0	PDE	EQ	A	07:24-07:36	13	20040/ 12
0762	83	03	12	071	08:49:45.7	18.098S	168.128E	VANUATU ISLANDS	33	5.6	5.9	PDE	EQ	A	08:52-09:03	12	20040/ 13
0763	83	03	12	071	12:30:17.5	4.268S	128.175E	BANDA SEA	33	5.0	0.0	PDE	EQ	A	12:33-12:45	13	20040/ 14
0764	83	03	12	071	14:25:27.2	31.575N	104.239E	SICHUAN PROVINCE CHINA	33	4.8	0.0	PDE	EQ	A	14:30-14:41	12	20040/ 15
0765	83	03	12	071	14:45:17.8	4.100S	128.058E	BANDA SEA	21	5.2	0.0	PDE	EQ	A	14:40-15:00	13	20040/ 16
0766	83	03	12	071	21:05:15.7	8.671N	93.809E	NICOBAR ISLANDS REGION	33	5.0	4.5	PDE	EQ	A	21:11-21:23	13	20040/ 17
0767	83	03	12	071	22:14:15.4	21.733N	143.870E	MARIANA ISLANDS REGION	33	4.8	0.0	PDE	EQ	ABD	22:14-22:27	14	20040/-18
0768	83	03	13	072	02:54:10.0	5.109S	147.610E	EAST PAPUA NEW GUINEA REGION	31	5.2	5.1	PDE	EQ	ABDE	02:55-03:39	45	20040/-19
0769	83	03	13	072	05:18:56.0	52.371N	157.475E	KAMCHATKA	33	5.1	0.0	PDE	EQ	ABDE	05:20-06:09	50	20040/ 20
0770	83	03	13	072	09:08:51.6	42.220N	142.606E	HOKKAIDO JAPAN REGION	40	4.8	0.0	PDE	EQ	ABD	09:10-09:25	16	20042/ 21
0771	83	03	13	072	10:05:45.2	52.321N	157.398E	KAMCHATKA	33	4.6	0.0	PDE	EQ	ABD	10:07-10:24	18	20040/ 22
0772	83	03	13	072	10:06:14.8	52.487N	157.478E	KAMCHATKA	33	4.8	0.0	PDE	EQ	ABD	10:08-10:24	17	20040/ 22
0773	83	03	13	072	20:05:57.7	54.117N	159.172E	NEAR E COAST OF KAMCHATKA	33	5.0	0.0	PDE	EQ	ABDE	20:08-20:57	50	20041/ 08
0774	83	03	13	072	20:20:08.8	41.563N	142.050E	HOKKAIDO JAPAN REGION	63	5.0	0.0	PDE	EQ	ABDE	20:21-21:06	46	20041/ 08
0775	83	03	13	072	23:30:14.6	51.973N	178.063E	RAT ISL. ALEUTIAN ISL.	142	4.7	0.0	PDE	EQ	ABD	23:32-23:46	17	20041/-09
0776	83	03	14	073	11:55:20.2	39.292N	54.633E	TURKMEN SSR	33	4.9	4.8	PDE	EQ	A	12:04-12:15	12	20041/ 10
0777	83	03	14	073	12:12:48.5	39.257N	54.522E	TURKMEN SSR	33	5.2	5.0	PDE	EQ	A	12:21-12:32	12	20041/ 11
0778	83	03	14	073	14:15:36.8	3.327S	177.524E	GILBERT ISLANDS REGION	33	5.0	0.0	PDE	EQ	ABDE	14:16-14:54	39	20041/ 12
0779	83	03	14	073	19:02:06.5	4.175S	127.824E	BANDA SEA	33	5.5	0.0	PDE	EQ	A	19:05-19:16	12	20041/ 13
0780	83	03	14	073	21:14:54.3	52.342N	170.152W	FOX ISL. ALEUTIAN ISL.	33	5.1	0.0	PDE	EQ	ABDE	21:17-22:09	53	20041/ 14
0781	83	03	15	074	12:37:53.2	7.099N	123.024E	MINDANAO PHILIPPINE ISLANDS	52	5.4	4.6	PDE	EQ	A	12:41-12:52	12	20041/ 15
0782	83	03	15	074	14:49:18.4	39.297N	54.550E	TURKMEN SSR	33	5.0	4.2	PDE	EQ	A	14:57-15:09	13	20041/ 16
0783	83	03	15	074	17:27:24.9	34.780N	137.566E	NEAR S COAST OF HONSHU JAPAN	31	5.4	4.9	PDE	EQ	ABDE	17:28-18:12	45	20041/ 17
0784	83	03	15	074	19:50:30.7	5.340N	126.609E	MINDANAO PHILIPPINE ISLANDS	47	5.7	6.6	PDE	EQ	AE	20:01-20:56	56	20041/ 18
0785	83	03	15	074	22:27:01.2	8.335S	122.642E	FLORES ISLAND REGION	172	4.6	0.0	PDE	EQ	A	22:31-22:42	12	20041/-19
0786	83	03	16	075	05:20:36.3	3.308S	140.310E	WEST IRIAN	11	5.1	0.0	PDE	EQ	A	05:30-05:42	13	20041/ 20
0787	83	03	16	075	09:13:10.7	3.441N	95.701E	OFF W COAST OF NORTH SUMATERA	30	5.3	0.0	PDE	EQ	A	09:19-09:31	13	20041/ 35
0788	83	03	17	076	02:53:08.8	12.207N	144.034E	SOUTH OF MARIANA ISLANDS	36	5.7	5.4	PDE	EQ	ABDE	02:53-03:28	36	20041/-36
0789	83	03	17	076	07:11:30.4	51.590N	142.491E	SAKHALIN ISLAND	41	5.6	4.9	PDE	EQ	A	07:14-07:25	12	20041/ 37
0790	83	03	17	076	10:10:40.4	12.004N	122.954E	LUZON PHILIPPINE ISLANDS	43	5.3	5.7	PDE	EQ	A	10:14-10:25	12	20041/ 38
0791	83	03	17	076	19:59:20.3	41.796N	142.760E	HOKKAIDO JAPAN REGION	131	5.3	0.0	PDE	EQ	ABDE	20:00-20:46	47	20041/ 39
0792	83	03	18	077	00:18:39.5	44.046N	139.179E	EASTERN SEA OF JAPAN	46	4.9	0.0	PDE	EQ	ABD	00:20-00:36	17	20041/-40
0793	83	03	18	077	03:37:03.0	22.443S	174.245W	TONGA ISLANDS REGION	40	5.4	0.0	PDE	EQ	A	08:40-08:52	13	20041/ 41
0794	83	03	18	077	09:05:50.1	4.057S	153.507E	NEW IRELAND REGION	88	6.4	7.0	PDE	EQ	ABDE	09:06-09:47	42	20041/ 42
0795	83	03	18	077	17:32:02.5	37.335N	70.745E	AFGHANISTAN-USSR BORDER REGION	33	4.8	0.0	PDE	EQ	A	17:39-17:51	13	20042/ 01
0796	83	03	18	077	17:50:14.4	4.665S	153.548E	NEW IRELAND REGION	98	5.0	0.0	PDE	EQ	ABDE	17:51-18:31	41	20042/ 01
0797	83	03	19	078	05:06:30.3	30.910N	103.515E	SICHUAN PROVINCE CHINA	33	4.5	0.0	PDE	EQ	A	06:11-06:23	13	20042/ 02
0798	83	03	19	078	11:46:24.2	51.601N	159.760E	OFF EAST COAST OF KAMCHATKA	37	5.2	5.1	PDE	EQ	ABDE	11:48-12:35	48	20042/ 08
0799	83	03	19	078	13:40:22.2	17.929S	179.444W	FIJI ISLANDS REGION	625	4.6	0.0	PDE	EQ	A	13:50-14:01	12	20042/ 09
0800	83	03	19	078	17:13:27.6	4.262S	152.765E	NEW BRITAIN REGION	17	5.3	5.4	PDE	EQ	ABDE	17:14-17:54	41	20042/ 10

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 5 JUL 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT NO	ORIGIN TIME YR	MO	DA	JUL	HR:MN:SECS	COORDINATES LAT	LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	SRF	INF SRC	EV TP	SAVED PHASES	INTERVAL	MNS	STRIP TAPE/FILE
0001	83	03	19	078	22:59:47.1	4.826S	153.812E	NEW IRELAND REGION	119	4.8	0.0	PDE	EQ	ABD	23:00-23:15	16	20042/-11
0002	83	03	20	079	11:24:48.4	2.375N	126.800E	MOLUCCA PASSAGE	58	5.5	0.0	PDE	EQ	A	11:28-11:39	12	20042/ 12
0003	83	03	20	079	13:45:49.8	4.727S	153.125E	NEW IRELAND REGION	86	5.9	0.0	PDE	EQ	ABDE	13:46-14:27	42	20042/ 13
0004	83	03	20	079	16:24:13.3	18.827S	177.762W	FIJI ISLANDS REGION	632	5.0	0.0	PDE	EQ	A	16:26-16:37	12	20042/ 14
0005	83	03	20	079	17:44:07.1	18.804S	177.679W	FIJI ISLANDS REGION	634	4.9	0.0	PDE	EQ	A	17:46-17:57	12	20042/ 15
0006	83	03	21	080	04:06:24.8	5.031S	153.698E	NEW IRELAND REGION	88	5.5	0.0	PDE	EQ	ABDE	04:07-04:48	42	20042/-16
0007	83	03	21	080	07:44:17.6	21.668S	175.321W	TONGA ISLANDS	70	6.3	0.0	PDE	EQ	A	07:47-07:59	13	20042/ 17
0008	83	03	21	080	07:57:18.4	7.342S	128.920E	BANDA SEA	143	5.6	0.0	PDE	EQ	A	08:00-08:12	13	20042/ 17
0009	83	03	21	080	15:23:40.7	36.502N	70.593E	HINDU KUSH REGION	166	4.2	0.0	PDE	EQ	A	15:31-15:42	12	20042/ 18
0010	83	03	21	080	15:49:52.8	21.394S	175.452W	TONGA ISLANDS	70	5.4	0.0	PDE	EQ	A	15:53-16:04	12	20042/ 19
0011	83	03	22	081	01:32:28.6	51.297N	178.481W	ANDREANOF ISL. ALEUTIAN ISL.	33	4.9	0.0	PDE	EQ	ABD	01:34-01:50	17	20042/-20
0012	83	03	22	081	20:17:07.5	53.211N	162.259E	OFF EAST COAST OF KAMCHATKA	33	4.7	0.0	PDE	EQ	ABD	20:19-20:35	17	20042/ 21
0013	83	03	23	082	06:09:29.6	6.618S	154.612E	SOLOMON ISLANDS	41	5.7	6.2	PDE	EQ	ABDE	06:10-06:52	43	20042/ 22
0014	83	03	23	082	06:40:32.1	6.663S	154.559E	SOLOMON ISLANDS	55	5.2	0.0	PDE	EQ	ABDE	06:41-07:23	43	20042/ 22
0015	83	03	23	082	08:26:55.2	6.627S	154.585E	SOLOMON ISLANDS	35	5.4	5.6	PDE	EQ	ABDE	08:28-09:09	42	20042/ 23
0016	83	03	23	082	12:11:23.9	37.011N	71.487E	AFGHANISTAN-USSR BORDER REGION	122	5.2	0.0	PDE	EQ	A	12:18-12:30	13	20042/ 24
0017	83	03	23	082	14:04:52.1	6.702S	154.528E	SOLOMON ISLANDS	68	5.2	0.0	PDE	EQ	ABDE	14:06-14:47	42	20043/ 01
0018	83	03	23	082	16:07:21.2	3.375S	177.491E	GILBERT ISLANDS REGION	27	4.8	0.0	PDE	EQ	ABD	16:07-16:21	15	20043/ 02
0019	83	03	23	082	21:54:36.3	37.224N	138.125E	NEAR W COAST OF HONSHU JAPAN	54	4.6	0.0	PDE	EQ	ABD	21:56-22:11	16	20043/ 03
0020	00	00	00	000	00:00:00.0	0.000N	0.000E	LOCAL PO, SO, T	0	0.0	0.0	HEL	EQ	BDE	00:22-00:51	30	20043/ 04
0021	83	03	24	083	07:01:40.9	10.551S	159.822E	SOLOMON ISLANDS	151	4.9	0.0	PDE	EQ	ABD	07:03-07:18	16	20043/ 05
0022	83	03	24	083	07:24:12.5	7.615S	107.173E	JAVA	57	4.9	0.0	PDE	EQ	A	07:30-07:41	12	20043/ 06
0023	83	03	24	083	08:44:53.9	6.602S	154.564E	SOLOMON ISLANDS	52	5.1	0.0	PDE	EQ	ABDE	08:46-09:27	42	20043/ 07
0024	83	03	24	083	10:47:40.5	4.721S	153.336E	NEW IRELAND REGION	80	5.2	0.0	PDE	EQ	ABDE	10:48-11:29	42	20043/ 08
0025	83	03	24	083	12:24:35.2	10.814S	163.992E	SOLOMON ISLANDS	74	4.9	0.0	PDE	EQ	ABD	12:25-12:41	17	20043/ 09
0026	00	00	00	000	00:00:00.0	0.002N	0.000E	PROBABLE MARIANAS PO, SO, T	0	0.0	0.0	HEL	EQ	BDE	20:10-20:39	30	20043/ 10
0027	83	03	25	084	07:44:01.2	6.555S	130.006E	BANDA SEA	164	5.4	0.0	PDE	EQ	A	07:47-07:58	12	20043/ 11
0028	83	03	25	084	13:00:14.2	6.494S	151.722E	NEW BRITAIN REGION	45	5.3	0.0	PDE	EQ	ABDE	13:01-13:44	44	20043/ 12
0029	83	03	25	084	19:33:54.1	8.395S	124.680E	TIMOR	169	4.8	0.0	PDE	EQ	A	19:37-19:49	13	20043/ 13
0030	83	03	25	084	21:41:54.8	6.490S	155.118E	SOLOMON ISLANDS	123	5.1	0.0	PDE	EQ	ABDE	21:42-22:24	43	20043/ 14
0031	83	03	26	085	10:51:43.4	39.139N	44.502E	N.W. IRAN-USSR BORDER REGION	33	4.6	0.0	PDE	EQ	A	11:00-11:20	21	20043/ 15
0032	83	03	26	085	12:46:47.7	5.105S	153.597E	NEW IRELAND REGION	78	4.9	0.0	PDE	EQ	ABD	12:47-13:02	16	20043/ 16
0033	83	03	26	085	14:57:49.3	1.167N	126.586E	MOLUCCA PASSAGE	73	5.2	0.0	PDE	EQ	A	15:01-15:12	12	20043/ 17
0034	83	03	26	085	17:19:37.5	4.631S	143.870E	PAPUA NEW GUINEA	101	4.5	0.0	PDE	EQ	ABD	17:21-17:37	17	20043/ 18
0035	83	03	26	085	18:42:46.8	42.047N	141.795E	HOKKAIDO JAPAN REGION	88	4.4	0.0	PDE	EQ	ABD	18:44-19:00	17	20043/ 19
0036	83	03	26	085	20:20:00.0	37.301N	116.460W	SOUTHERN NEVADA	0	5.1	0.0	PDE	NX	A	20:26-20:37	12	20044/ 01
0037	83	03	27	086	02:42:41.4	34.260N	92.644E	QINGHAI PROVINCE CHINA	33	4.5	0.0	PDE	EQ	A	02:48-03:00	13	20044/ 02
0038	83	03	27	086	09:04:33.5	27.514N	141.378E	BONIN ISLANDS REGION	38	4.8	0.0	PDE	EQ	ABD	09:05-09:19	15	20044/ 03
0039	83	03	27	086	18:32:00.1	4.838S	153.560E	NEW IRELAND REGION	95	4.9	0.0	PDE	EQ	ABD	18:33-18:47	15	20044/ 04
0040	83	03	27	086	20:05:07.6	6.893S	148.454E	NEW BRITAIN REGION	33	5.0	0.0	PDE	EQ	ABDE	20:06-20:51	46	20044/ 05
0041	83	03	28	087	19:17:58.8	26.306N	127.311E	RYUKYU ISLANDS	62	5.3	0.0	PDE	EQ	A	19:20-19:31	12	20044/ 06
0042	83	03	28	087	23:38:27.2	12.986N	146.354E	SOUTH OF MARIANA ISLANDS	33	4.7	0.0	PDE	EQ	ABD	23:38-23:51	14	20044/ 07
0043	83	03	29	088	04:53:09.4	30.443N	131.508E	KYUSHU JAPAN	33	4.9	0.0	PDE	EQ	ABD	04:55-05:11	17	20044/ 08
0044	83	03	29	088	22:55:47.8	6.904S	154.807E	SOLOMON ISLANDS	33	5.1	0.0	PDE	EQ	ABDE	22:57-23:38	42	20044/ 09
0045	83	03	30	089	00:49:09.9	1.572N	122.513E	MINAHASSA PENINSULA	40	5.4	5.1	PDE	EQ	A	00:53-01:04	12	20044/ 10
0046	83	03	30	089	06:46:22.5	40.001N	75.033E	KIRGHIZ-XINJIANG BORDER REGION	33	4.9	4.9	PDE	EQ	A	06:53-07:05	13	20044/ 11
0047	83	03	30	089	12:02:52.3	6.637S	154.560E	SOLOMON ISLANDS	33	4.8	0.0	PDE	EQ	ABD	12:04-12:18	15	20044/ 12
0048	83	03	30	089	16:13:35.2	39.884N	75.480E	SOUTHERN XINJIANG CHINA	33	4.8	0.0	PDE	EQ	A	16:21-16:32	12	20044/ 13
0049	83	03	30	089	18:55:49.1	5.919S	142.220E	PAPUA NEW GUINEA	33	5.2	0.0	PDE	EQ	ABDE	18:58-19:46	49	20044/ 14
0050	83	03	31	090	13:24:45.6	34.281N	135.833E	NEAR S COAST OF SOUTH HONSHU	380	4.9	0.0	PDE	EQ	ABDE	13:25-14:11	47	20044/ 15
0051	83	04	01	091	01:04:59.0	18.534N	145.806E	MARIANA ISLANDS	102	5.1	0.0	PDE	EQ	ABDE	01:04-01:36	33	20044/ 16
0052	00	00	02	000	00:00:02.0	0.020N	0.000E	PROBABLE BONIN PO, SO, T	0	0.0	0.0	HEL	EQ	BDE	20:43-21:12	30	20044/ 17
0053	83	04	02	092	04:10:23.5	3.123S	135.287E	WEST IRIAN	33	5.0	0.0	PDE	EQ	A	04:20-04:32	13	20044/ 18
0054	83	04	02	092	05:09:18.3	54.099N	160.314E	NEAR EAST COAST OF KAMCHATKA	92	4.9	0.0	PDE	EQ	ABD	05:11-05:26	16	20044/ 19
0055	83	04	02	092	06:49:01.9	24.711S	176.196W	SOUTH OF FIJI ISLANDS	40	5.4	5.0	PDE	EQ	A	06:52-07:04	13	20044/ 20
0056	83	04	02	092	21:04:30.6	6.327S	154.533E	SOLOMON ISLANDS	44	4.6	0.0	PDE	EQ	ABD	21:05-21:20	16	20044/ 21
0057	83	04	02	092	21:55:44.0	36.393N	70.734E	HINDU KUSH REGION	215	4.8	0.0	PDE	EQ	A	22:03-22:14	12	20045/ 01
0058	83	04	03	093	02:50:00.7	8.731N	83.115W	COSTA RICA	33	6.6	7.2	PDE	EQ	AE	02:59-05:08	130	20045/ 02
0059	83	04	03	093	10:14:53.0	0.671N	124.181E	MINAHASSA PENINSULA	174	5.0	0.0	PDE	EQ	A	10:18-10:29	12	20045/ 03
0060	83	04	03	093	19:14:05.2	51.997N	179.255E	RAT ISL. ALEUTIAN ISL.	116	5.6	0.0	PDE	EQ	ABDE	19:16-20:04	49	20045/ 04
0061	83	04	03	093	19:26:24.5	51.809N	176.919W	ANDREANOF ISL. ALEUTIAN ISL.	60	5.3	0.0	PDE	EQ	ABDE	19:28-20:17	50	20045/ 04
0062	83	04	04	094	00:45:07.9	38.517N	70.334E	AFGHANISTAN-USSR BORDER REGION	33	4.9	0.0	PDE	EQ	A	00:52-01:04	13	20045/ 05
0063	83	04	04	094	02:51:34.9	5.730N	94.811E	NORTHERN SUMATERA	85	6.5	0.0	PDE	EQ	A	02:58-03:09	12	20045/ 06
0064	83	04	04	094	03:03:35.0	5.752N	94.798E	NORTHERN SUMATERA	74	5.8	0.0	PDE	EQ	A	03:10-03:21	12	20045/ 06
0065	00	02	00	000	02:00:00.0	0.000N	0.000E	PROBABLE BONIN'S PO, SO, T	0	0.0	0.0	HEL	EQ	BDE	05:25-05:54	30	20045/ 07
0066	83	04	04	094	06:58:59.5	5.585N	94.640E	NORTHERN SUMATERA	76	5.0	0.0	PDE	EQ	A	07:05-07:16	12	20045/ 08
0067	83	04	04	094	19:04:20.8	52.923N	159.916E	OFF EAST COAST OF KAMCHATKA	38	6.0	5.5	PDE	EQ	ABDE	19:06-19:54	49	20045/ 09
0068	83	04	04	094	19:48:04.1	7.057S	129.379E	BANDA SEA	144	5.0	0.0	PDE	EQ	A	19:51-20:02	12	20045/ 09
0069	83	04	04	094	23:12:47.0	49.399N	155.648E	KURIL ISLANDS	50	6.1	6.5	PDE	EQ	ABDE	23:14-23:59	46	20045/ 10
0070	83	04	04	094	23:58:59.6	15.019S	167.274E	VANUATU ISLANDS	127	6.1	0.0	PDE	EQ	ABDE	00:00-00:49	50	20045/ 10
0071	83	04	05	095	00:55:24.6	41.631N	70.763E	KIRGHIZ SSR	33	5.1	0.0	PDE	EQ	A	01:03-01:14	12	20045/ 11
0072	83	04	05	095	06:50:33.5	40.062N	75.285E	KIRGHIZ-XINJIANG BORDER REGION	33	5.4	5.6	PDE	EQ	A	06:57-07:09	13	20046/ 01
0073	83	04	05	095	07:07:23.5	39.874N	75.449E	SOUTHERN XINJIANG CHINA	33	4.8	0.0	PDE	EQ	A	07:14-07:26	13	20046/ 02
0074	83	04	05	095	07:40:38.3	5.438N	126.698E	MINDANAO PHILIPPINE ISLANDS	41	5.1	0.0	PDE	EQ	A	07:43-07:54	12	20046/ 03
0075	83	04	05	095	21:39:08.0	26.489N	126.488E	RYUKYU ISLANDS	121	4.7	0.0	PDE	EQ	ABD	21:41-21:58	18	20046/ 04
0076	83	04	06	096	00:50:23.7	6.171S	149.865E	NEW BRITAIN REGION	53	4.8	4.7	PDE	EQ	ABD	00:51-01:07	17	20046/ 05
0077	83	04	06	096	02:00:11.8	36.438N	71.477E	AFGHANISTAN-USSR BORDER REGION	101	4.7	0.0	PDE	EQ	A	02:15-02:27	13	20046/ 06
0078	83	04	06	096	10:30:36.6	5.548S	153.560E	NEW IRELAND REGION	68	4.6	0.0	PDE	EQ	ABD	10:31-10:46	16	20046/ 07
0079	83	04	06	096	12:49:00.4	39.974N	75.129E	SOUTHERN XINJIANG CHINA	33	4.7	0.0	PDE	EQ	A	12:56-13:07	12	20046/ 08
0080	83	04	06	096	18:00:08.2	21.614S	179.391W	FIJI ISLANDS REGION	636	4.9	0.0	PDE	EQ	A	18:10-18:21	12	20046/ 09
0081	83	04	06	096	21:17:32.1	2.020S	128.166E	CERAM SEA	33	5.0	0.0	PDE	EQ	A	21:20-21:32	13	20046/ 10
0082	83	04	06	096	22:18:47.5	38.846N	71.488E	AFGHANISTAN-USSR BORDER REGION	33	5.2	4.7	PDE	EQ	A	22:26-22:37	12	20046/-11
0083	83	04	07	097	05:04:22.3	5.996S	100.752E	SOUTHWEST OF SUMATERA	33	5.0	0.0	PDE	EQ	A	05:10-05:22	13	20046/ 12
0084	83	04	07	097	22:56:52.3	54.512N	160.929E	NEAR EAST COAST OF KAMCHATKA	33	5.1	0.0	PDE	EQ	ABDE	22:59-23:48	50	20046/-13
0085	83	04	08	098	02:28:25.5	11.448N	57.509E	ARABIAN SEA	10	5.8	6.2	PDE	EQ	F	02:30-04:29	120	20046/-14
0086	83	04	08	098	06:21:24.8	5.640N	94.719E	NORTHERN SUMATERA	76	4.8	0.0	PDE	EQ	A	06:28-06:39	12	20046/ 15
0087	83	04	08	098	14:10:53.3	49.636N	155.286E	KURIL ISLANDS	82	5.0	0.0	PDE	EQ	ABDE	14:12-14:58	47	20046/ 16
0088	83	04	09	099	22:00:36.6	41.919N	142.421E	HOKKAIDO JAPAN REGION	64	4.5	0.0	PDE	EQ	ABD	22:02-22:17	16	20046/ 17
0089	83	04	10	100	02:20:36.3	17.636S	174.640W	TONGA ISLANDS	33	5.4	5.3	PDE	EQ	A	02:23-02:34	12	20046/ 18
0090	83	04	10	100	05:30:47.7	40.026N	77.060E	KIRGHIZ-XINJIANG BORDER REGION	33	4.8	4.4	PDE	EQ	A	05:46-05:57	12	20046/ 19
0091	83	04	10	100	05:51:37.6	22.128S	179.709W	SOUTH OF FIJI ISLANDS	600	5.3	0.0	PDE	EQ	A	05:54-06:05	12	20046/ 19
0092	83	04	10	100	12:19:37.5	2.302N	125.705E	MOLUCCA PASSAGE	94	5.0	0.0	PDE	EQ	A	12:22-12:33	12	20046/ 20
0093	83	04	10	100	18:29:35.4	30.709N	141.952E	SOUTH OF HONSHU JAPAN	33	5.3	5.3	PDE	EQ	ABDE	18:30-19:08	39	20046/ 21
0094	83	04	11	101	08:18:10.3	10.449N	62.706W	NEAR COAST OF VENEZUELA	43	6.0	5.8	PDE	EQ	A	08:27-08:46	20	20046/ 22
0095	83	04	11	101	14:32:54.9	40.319N	53.003E	TURKMEN SSR	33	4.8	0.0	PDE	EQ	A	14:41-14:52	12	20046/ 23
0096	83	04	11	101	15:34:55.6	44.30.N	147.775E	KURIL ISLANDS	98	5.7	0.0	PDE	EQ	ABDE	15:36-16:19	44	20046/ 24
0097	83	04	11	101	17:03:45.9	35.480S	179.383W	EAST OF NORTH ISLAND	84	5.7	0.0	PDE	EQ	A	17:08-17:19	12	20046/ 25
0098	83	04	12	102	03:41:05.2	49.815N	78.227E	EASTERN KAZAKH SSR	0	4.9	0.0	PDE	NX	A	03:48-03:59	12	20046/ 26
0099	83	04	12	102	12:07:54.6	4.065S	78.183W	PERU-ECUADOR BORDER REGION	107	6.5	[illegible]	PDE	EQ	A	12:17-12:36	20	20046/ 27
0100	83	04	12	102	16:00:56.4	12.168S	167.080E	SANTA CRUZ ISLANDS	291	5.1	[illegible]	PDE	EQ	A	16:02-16:13	12	20046/ 28

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 13 AUG 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PU, C=S, D=SO, E=T, F=OTHER

EVNT NO	YR	MO	DA	JUL	ORIGIN TIME HR:MN:SECS	LAT	LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	MAGNI SRF	INF SRC	EV TP	PHASES	SAVED INTERVAL	MNS	STRIP TAPE/FILE
0901	83	04	12	102	22:44:49.5	5.151S	153.637E	NEW IRELAND REGION	55	5.3	5.5	PDE	EQ	ABDE	22:45-23:26	42	22247/ 01
0902	83	04	13	103	14:44:09.5	10.559S	164.683E	SANTA CRUZ ISLANDS REGION	33	5.0	4.9	PDE	EQ	A	14:45-14:56	12	22247/ 02
0903	83	04	13	103	15:26:37.0	14.577N	146.904E	MARIANA ISLANDS	58	4.7	0.0	PDE	EQ	ABD	15:26-15:39	14	22247/ 03
0904	83	04	13	103	19:41:24.5	46.941N	145.630E	NORTHWEST OF KURIL ISLANDS	354	4.5	0.0	PDE	EQ	ABDE	19:42-20:29	46	22247/ 04
0905	83	04	13	103	21:07:22.8	22.816N	94.537E	BURMA	130	4.7	0.0	PDE	EQ	A	21:13-21:24	12	22247/ 05
0906	83	04	14	104	02:46:26.7	14.811N	146.967E	MARIANA ISLANDS	33	4.5	0.0	PDE	EQ	ABD	02:46-02:58	13	22247/ 06
0907	83	04	14	104	04:03:48.3	10.431S	165.225E	SANTA CRUZ ISLANDS	33	5.0	4.4	PDE	EQ	A	04:05-04:16	12	22247/ 07
0908	83	04	14	104	06:09:38.4	36.363N	71.112E	AFGHANISTAN-USSR BORDER REGION	224	4.6	0.0	PDE	EQ	A	06:17-06:28	12	22247/ 08
0909	83	04	14	104	09:12:01.2	35.953N	69.969E	HINDU KUSH REGION	78	4.7	0.0	PDE	EQ	A	09:19-09:31	13	22247/ 09
0910	83	04	14	104	10:24:12.2	22.126S	175.0[illegible]W	TONGA ISLANDS REGION	33	5.2	5.1	PDE	EQ	A	10:27-10:39	13	22247/ 10
0911	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO, SO, T	0	0.0	0.0	HEL	EQ	BDE	11:18-11:47	30	22247/ 11
0912	83	04	14	104	19:05:00.1	37.073N	116.046W	SOUTHERN NEVADA	0	5.7	0.0	PDE	NX	A	19:11-19:22	12	22247/ 12
0913	83	04	14	104	23:01:12.2	0.275N	126.113E	MOLUCCA PASSAGE	64	5.0	0.0	PDE	EQ	A	23:04-23:15	12	22247/ 13
0914	83	04	15	105	00:09:36.1	19.896S	175.611W	TONGA ISLANDS	249	5.7	0.0	PDE	EQ	A	00:12-00:23	12	22247/ 14
0915	83	04	15	105	04:44:00.7	6.502S	154.948E	SOLOMON ISLANDS	33	5.9	5.5	PDE	EQ	ABDE	04:45-05:26	42	22247/ 15
0916	83	04	15	105	09:23:59.1	14.954N	99.142E	SOUTHEAST ASIA	10	5.3	0.0	PDE	EQ	A	09:30-09:41	12	22247/ 16
0917	83	04	15	105	14:21:49.0	13.130N	121.971E	MINDORO PHILIPPINE ISLANDS	33	5.3	5.1	PDE	EQ	A	14:25-14:36	12	22247/ 17
0918	83	04	15	105	14:51:59.8	53.355N	163.401E	NEAR EAST COAST OF KAMCHATKA	71	5.8	0.0	PDE	EQ	ABDE	14:54-15:42	49	22247/ 18
0919	83	04	16	106	12:57:45.6	10.186S	110.892E	SOUTH OF JAVA	23	5.8	5.3	PDE	EQ	A	13:03-13:14	12	22247/ 19
0920	83	04	16	106	17:23:29.5	4.795N	127.664E	TALAUD ISLANDS	83	5.1	0.0	PDE	EQ	A	17:26-17:37	12	22247/ 20
0921	83	04	16	106	17:28:31.2	41.475N	142.040E	HOKKAIDO JAPAN REGION	62	5.0	0.0	PDE	EQ	ABDE	17:29-18:14	46	22247/ 20
0922	83	04	17	107	13:00:14.1	1.779N	99.520E	NORTHERN SUMATERA	178	4.5	0.0	PDE	EQ	A	13:06-13:17	12	22247/ 21
0923	83	04	17	107	14:06:56.3	22.747S	169.183E	VANUATU ISLANDS	22	5.4	6.2	PDE	EQ	ABDE	14:09-15:04	56	22248/ 01
0924	83	04	17	107	19:14:47.2	36.612N	71.014E	AFGHANISTAN-USSR BORDER REGION	270	4.5	0.0	PDE	EQ	A	19:22-19:33	12	22248/ 02
0925	83	04	17	107	20:05:44.9	44.840N	147.615E	KURIL ISLANDS	115	4.9	0.0	PDE	EQ	ABDE	20:07-20:51	45	22248/ 03
0926	83	04	17	107	23:16:34.5	22.001N	94.327E	BURMA	100	5.1	0.0	PDE	EQ	A	23:22-23:33	12	22248/ 04
0927	83	04	18	108	05:01:19.4	19.894S	175.889W	TONGA ISLANDS	241	5.1	0.0	PDE	EQ	A	05:04-05:15	12	22248/ 05
0928	83	04	18	108	10:58:47.9	27.721N	62.058E	SOUTHERN IRAN	37	6.5	6.2	PDE	EQ	F	11:00-12:59	120	22248/ 06
0929	83	04	18	108	13:52:13.2	8.276S	119.638E	FLORES ISLAND REGION	191	6.0	0.0	PDE	EQ	A	13:56-14:07	12	22248/ 07
0930	83	04	18	108	16:29:37.5	52.111N	159.137E	OFF EAST COAST OF KAMCHATKA	70	4.7	0.0	PDE	EQ	ABD	16:31-16:47	17	22248/ 08
0931	83	04	18	108	17:15:04.0	13.639S	167.209E	VANUATU ISLANDS	213	5.1	0.0	PDE	EQ	A	17:16-17:27	12	22248/ 09
0932	83	04	18	108	18:28:10.8	43.524N	147.688E	KURIL ISLANDS	38	4.9	0.0	PDE	EQ	ABD	18:29-18:44	16	22248/ 10
0933	83	04	19	109	09:11:01.1	4.389S	144.069E	NEAR N COAST PAPUA NEW GUINEA	137	5.2	0.0	PDE	EQ	ABD	09:12-09:28	17	22248/ 11
0934	83	04	19	109	14:17:59.8	21.499N	145.777E	MARIANA ISLANDS REGION	33	4.3	0.0	PDE	EQ	ABD	14:17-14:30	14	22248/ 12
0935	83	04	19	109	14:26:29.1	14.823S	167.478E	VANUATU ISLANDS	149	5.0	0.0	PDE	EQ	ABDE	14:28-15:16	49	22248/ 12
0936	83	04	19	109	15:05:41.2	29.359N	139.727E	SOUTH OF HONSHU JAPAN	464	4.5	0.0	PDE	EQ	ABDE	15:06-15:47	42	22248/ 12
0937	83	04	19	109	15:15:10.7	7.253S	129.205E	BANDA SEA	186	5.0	0.0	PDE	EQ	A	15:18-15:29	12	22248/ 12
0938	83	04	19	109	16:25:27.2	46.449N	153.131E	KURIL ISLANDS	33	4.5	0.0	PDE	EQ	ABD	16:26-16:42	17	22248/ 13
0939	83	04	19	109	18:52:58.4	21.864S	138.941W	TUAMOTU ARCHIPELAGO REGION	0	5.6	0.0	PDE	NX	A	18:59-19:10	12	22248/ 14
0940	83	04	19	109	19:12:48.7	63.372N	149.950W	CENTRAL ALASKA	113	5.1	0.0	PDE	EQ	ABD	19:17-19:38	22	22249/ 01
0941	83	04	20	110	11:01:39.0	5.521S	129.449E	BANDA SEA	282	5.2	0.0	PDE	EQ	A	11:04-11:15	12	22249/ 02
0942	83	04	20	110	16:34:32.2	12.423N	143.701E	SOUTH OF MARIANA ISLANDS	50	4.9	0.0	PDE	EQ	ABD	16:34-16:48	15	22249/ 03
0943	83	04	21	111	13:39:24.5	15.539N	146.151E	MARIANA ISLANDS	95	5.0	0.0	PDE	EQ	ABDE	13:39-14:11	33	22249/ 05
0944	83	04	21	111	10:25:09.0	0.823N	125.965E	MOLUCCA PASSAGE	63	5.2	0.0	PDE	EQ	A	10:28-10:39	12	22249/ 04
0945	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO, SO, T	0	0.0	0.0	HEL	EQ	BDE	21:57-22:26	30	22249/ 06
0946	83	04	22	112	00:37:40.5	14.952N	99.072E	SOUTHEAST ASIA	33	5.8	5.8	PDE	EQ	A	00:43-00:54	12	22249/ 07
0947	83	04	22	112	03:21:40.6	14.960N	99.061E	SOUTHEAST ASIA	33	5.2	4.4	PDE	EQ	A	03:27-03:38	12	22249/ 08
0948	83	04	22	112	03:56:26.6	39.321N	64.271E	UZBEK SSR	46	4.8	0.0	PDE	EQ	A	04:04-04:15	12	22249/ 09
0949	83	04	22	112	07:51:49.0	6.152N	126.984E	MINDANAO PHILIPPINE ISLANDS	59	5.7	0.0	PDE	EQ	A	07:54-08:05	12	22249 10
0950	83	04	22	112	10:32:41.7	39.250N	68.313E	TAJIK SSR	33	4.8	0.0	PDE	EQ	A	10:40-10:51	12	22249 11
0951	83	04	22	112	13:53:00.0	37.112N	116.022W	SOUTHERN NEVADA	0	4.0	0.0	PDE	NX	A	13:59-14:10	12	22249/ 12
0952	00	02	00	002	00:00:20.0	0.000N	0.020E	PROBABLE BONIN ISL. PO,SO,T	0	0.0	0.0	HEL	EQ	BDE	14:32-15:01	30	22249/ 13
0953	83	04	22	112	18:28:24.5	42.369N	87.942E	NORTHERN XINJIANG CHINA	24	5.1	4.1	PDE	EQ	A	18:34-18:46	13	22249/ 14
0954	83	04	23	113	00:30:50.3	6.391S	151.853E	NEW BRITAIN REGION	33	5.0	0.0	PDE	EQ	ABDE	00:32-01:14	43	22249/ 15
0955	83	04	23	113	04:23:55.6	30.272N	67.945E	PAKISTAN	33	4.7	4.2	PDE	EQ	A	04:22-04:43	12	22249/ 16
0956	83	04	23	113	09:20:13.0	11.353S	118.841E	SOUTH OF SUMBAWA ISLAND	21	5.4	0.0	PDE	EQ	A	09:25-09:36	12	22249/ 17
0957	83	04	23	113	18:49:54.0	29.529N	68.290E	PAKISTAN	33	4.8	4.3	PDE	EQ	A	18:58-19:09	12	22249/ 18
0958	83	04	23	113	23:33:58.8	53.090S	117.830W	EASTER ISLAND CORDILLERA	10	5.0	5.5	PDE	EQ	ABD	23:42-00:16	35	0/ 00
0959	83	04	24	114	03:26:39.8	16.354S	177.694W	FIJI ISLANDS REGION	33	4.9	5.6	PDE	EQ	A	03:29-03:40	12	0/ 02
0960	83	04	24	114	03:29:18.2	23.918S	176.029W	SOUTH OF FIJI ISLANDS	33	5.9	5.5	PDE	EQ	A	03:32-03:44	13	0/ 02
0961	83	04	24	114	04:48:13.8	35.839N	139.776E	NEAR S COAST OF HONSHU JAPAN	98	4.7	0.0	PDE	EQ	ABD	04:49-05:04	16	0/ 02
0962	83	04	24	114	09:08:05.6	13.239N	146.309E	SOUTH OF MARIANA ISLANDS	33	5.1	0.0	PDE	EQ	ABDE	09:06-09:40	33	22249/ 19
0963	83	04	24	114	09:08:49.0	8.912S	157.649E	SOLOMON ISLANDS	18	5.8	6.2	PDE	EQ	ABDE	09:10-09:53	44	22249/ 19
0964	83	04	24	114	15:56:33.1	19.805S	173.219W	TONGA ISLANDS	51	5.1	0.0	PDE	EQ	A	15:59-16:11	13	22249/ 20
0965	83	04	25	115	01:59:46.9	53.943N	159.368E	NEAR EAST COAST OF KAMCHATKA	111	4.4	0.0	PDE	EQ	ABDE	02:01-02:51	51	22249/ 21
0966	83	04	25	115	11:13:11.5	8.786S	157.396E	SOLOMON ISLANDS	33	5.0	0.0	PDE	EQ	ABDE	11:14-11:57	44	22250/ 01
0967	83	04	25	115	13:55:58.8	46.391N	142.332E	SAKHALIN ISLAND	311	4.7	0.0	PDE	EQ	ABDE	13:57-14:45	49	22250/ 02
0968	83	04	25	115	14:00:43.3	51.331N	156.928E	KAMCHATKA	97	5.2	0.0	PDE	EQ	ABDE	14:02-14:49	48	22250/ 02
0969	83	04	25	115	17:57:01.8	5.456S	146.860E	EAST PAPUA NEW GUINEA	241	5.1	0.0	PDE	EQ	ABDE	17:58-18:43	46	22250/ 03
0970	83	04	25	115	19:03:47.8	12.777N	123.042E	LUZON PHILIPPINE ISLANDS	23	5.0	4.5	PDE	EQ	A	19:07-19:18	12	22250/ 04
0971	83	04	25	115	23:24:20.9	55.618N	160.675E	KAMCHATKA	168	4.7	0.0	PDE	EQ	ABDE	23:26-00:18	53	22250/ 05
0972	83	04	26	116	11:15:37.6	15.891S	168.365E	VANUATU ISLANDS	33	5.6	5.5	PDE	EQ	ABD	11:17-11:34	18	22250/ 06
0973	83	04	26	116	12:38:10.7	6.493S	105.374E	SUNDA STRAIT	75	5.0	0.0	PDE	EQ	A	12:44-12:55	12	22250/ 07
0974	83	04	26	116	15:26:40.9	24.632N	122.545E	TAIWAN REGION	123	5.6	0.0	PDE	EQ	A	15:29-15:40	12	22250/ 08
0975	83	04	26	116	16:02:17.5	48.606N	153.465E	KURIL ISLANDS	155	4.9	0.0	PDE	EQ	ABDE	16:03-16:49	47	22250/ 09
0976	83	04	26	116	18:15:37.0	24.220N	121.741E	TAIWAN	67	4.9	0.0	PDE	EQ	A	18:18-18:30	13	22250/ 10
0977	83	04	27	117	00:46:51.6	6.318S	151.318E	NEW BRITAIN REGION	40	4.9	0.0	PDE	EQ	ABD	00:48-01:03	16	22250/ 11
0978	83	04	27	117	16:28:19.3	36.228N	70.760E	HINDU KUSH REGION	161	4.7	0.0	PDE	EQ	A	16:35-16:47	13	22250/ 12
0979	83	04	27	117	17:20:35.1	20.969S	174.532W	TONGA ISLANDS	21	5.5	5.6	PDE	EQ	A	17:24-17:35	12	22250/ 13
0980	83	04	28	118	08:58:06.8	51.119N	156.331E	KAMCHATKA	120	4.9	0.0	PDE	EQ	ABDE	08:59-09:46	48	22250/ 14
0981	83	04	29	119	06:11:07.8	5.979S	147.710E	E. PAPUA NEW GUINEA REGION	100	4.9	0.0	PDE	EQ	ABD	06:12-06:28	17	22250/ 15
0982	83	04	29	119	13:39:11.1	35.334N	139.010E	NEAR S COAST OF HONSHU JAPAN	33	4.8	0.0	PDE	EQ	ABD	13:40-13:55	16	22250/ 16
0983	83	04	30	120	02:51:44.8	21.296S	174.333W	TONGA ISLANDS	33	5.8	5.5	PDE	EQ	A	02:55-03:06	12	22251/ 01
0984	83	04	30	120	14:03:49.7	41.523N	143.784E	HOKKAIDO JAPAN REGION	33	6.5	6.3	PDE	EQ	ABDE	14:05-14:48	44	22251/ 02
0985	83	04	30	120	15:50:24.6	41.629N	143.587E	HOKKAIDO JAPAN REGION	33	4.8	0.0	PDE	EQ	ABD	15:51-16:07	17	22251/ 03
0986	83	04	30	120	15:57:09.1	41.613N	143.672E	HOKKAIDO JAPAN REGION	33	4.8	5.1	PDE	EQ	ABD	15:58-16:13	16	22251/ 03
0987	83	04	30	120	17:28:46.6	25.648N	96.843E	BURMA	33	4.5	0.0	PDE	EQ	A	17:34-17:45	12	22251/ 04
0988	83	04	30	120	19:04:30.2	49.503N	155.742E	KURIL ISLANDS	46	5.3	5.1	PDE	EQ	ABDE	19:06-19:51	46	22251/ 05
0989	83	04	30	120	19:24:27.6	5.529S	129.316E	BANDA SEA	250	4.0	0.0	PDE	EQ	A	19:27-19:38	12	22251/ 05
0990	83	05	01	121	00:14:24.3	18.015S	178.296W	FIJI ISLANDS REGION	595	4.8	0.0	PDE	EQ	A	00:16-00:27	12	22251/ 06
0991	83	05	01	121	08:44:10.3	38.436N	144.476E	OFF E COAST OF HONSHU JAPAN	43	4.7	0.0	PDE	EQ	ABD	08:45-08:59	15	22251/ 07
0992	83	05	01	121	15:25:34.9	2.981N	124.691E	CELEBES SEA	296	4.5	0.0	PDE	EQ	A	15:28-15:39	12	22251/ 08
0993	83	05	01	121	18:10:41.5	46.356N	153.497E	KURIL ISLANDS	33	6.1	6.0	PDE	EQ	ABDE	18:11-18:55	45	22251/ 09
0994	83	05	01	121	20:11:58.6	46.363N	153.437E	KURIL ISLANDS	33	5.6	5.4	PDE	EQ	ABDE	20:13-20:56	44	22251 10
0995	83	05	02	122	01:22:17.7	5.876S	12[illegible]1E	BANDA SEA	306	5.0	0.0	PDE	EQ	A	01:25-01:36	12	22251/ 11
0996	83	05	02	122	06:59:58.6	8.65[illegible]S	10[illegible].368E	SOUTH OF JAVA	33	5.3	5.2	PDE	EQ	A	07:06-07:17	12	22251/ 12
0997	00	03	00	000	00:00:00.0	0.000N	0.000E	UNKNOWN P	0	0.0	0.0	HEL	EQ	A	10:00-10:14	15	22251/ 13
0998	83	05	02	122	15:21:51.2	46.279N	15[illegible].616E	KURIL ISLANDS	33	5.1	5.1	PDE	EQ	ABDE	15:23-16:06	44	22251/ 14
0999	83	05	02	122	21:22:44.0	46.265N	153.592E	KURIL ISLANDS	33	5.3	5.3	PDE	EQ	ABDE	21:24-22:06	43	22251/ 15
1000	83	05	02	122	23:42:37.9	36.242N	120.381W	CENTRAL CALIFORNIA	12	6.2	6.5	PDE	EQ	ABDE	23:48-01:10	83	22252/ 01

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 13 AUG 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT NO	YR	MO	DA	JUL	ORIGIN TIME HR MN SECS	LAT	LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	MAGNI SRF	INF SRC	EV TP	PHASES	SAVED INTERVAL	MNS	STRIP TAPE/FILE
1001	83	05	03	123	02:38:15.4	46.409N	153.492E	KURIL ISLANDS	33	5.1	0.0	PDE	EQ	ABDE	02:39-03:22	44	20252/ 02
1002	83	05	03	123	15:39:39.3	20.212S	176.345W	FIJI ISLANDS REGION	593	5.5	0.0	PDE	EQ	A	15:41-15:53	13	20252/ 03
1003	83	05	03	123	18:37:13.4	46.293N	153.535E	KURIL ISLANDS	33	5.2	4.7	PDE	EQ	ABDE	18:38-19:21	44	20252/ 04
1004	83	05	03	123	21:02:15.2	3.885N	125.503E	TALAUD ISLANDS	64	5.0	0.0	PDE	EQ	A	21:05-21:16	12	20252/ 05
1005	83	05	04	124	07:58:25.4	9.443S	143.670E	EAST PAPUA NEW GUINEA REGION	15	5.0	4.9	PDE	EQ	ABDE	08:00-08:47	48	20252/ 06
1006	83	05	04	124	14:29:38.3	42.653N	142.979E	HOKKAIDO JAPAN REGION	107	4.3	0.0	PDE	EQ	ABDE	14:31-15:16	46	20252/ 07
1007	83	05	05	125	04:43:59.4	33.829S	179.383E	SOUTH OF KERMADEC ISLANDS	97	6.0	0.0	PDE	EQ	A	04:48-04:59	12	20252/ 08
1008	83	05	05	125	06:19:45.2	38.762N	72.354E	TAJIK SSR	33	4.9	0.0	PDE	EQ	A	06:27-06:38	12	20252/ 09
1009	83	05	05	125	07:14:19.9	3.187S	135.165E	WEST IRIAN REGION	33	5.4	0.0	PDE	EQ	A	07:17-07:28	12	20253/ 01
1010	83	05	05	125	15:20:00.0	37.012N	116.089W	SOUTHERN NEVADA	0	4.5	0.0	PDE	NX	A	15:26-15:37	12	20253/ 02
1011	83	05	06	126	04:16:15.2	43.107N	145.934E	KURIL ISLANDS	34	5.2	5.0	PDE	EQ	ABDE	04:17-05:00	44	20253/ 03
1012	83	05	06	125	11:59:41.4	21.324S	174.152W	TONGA ISLANDS	33	5.2	4.7	PDE	EQ	A	12:03-12:14	12	20253/ 04
1013	83	05	06	126	18:24:18.5	15.439N	121.691E	LUZON PHILIPPINE ISLANDS	33	5.6	5.6	PDE	EQ	A	18:27-18:38	12	20253/ 05
1014	83	05	07	127	06:11:24.1	6.048S	147.418E	EAST PAPUA NEW GUINEA REGION	119	5.2	0.0	PDE	EQ	ABDE	06:13-06:57	45	20253/ 06
1015	83	05	07	127	08:20:39.8	9.702S	159.504E	SOLOMON ISLANDS	33	5.0	0.0	PDE	EQ	ABDE	08:22-09:05	44	20253/ 07
1016	83	05	07	127	22:40:16.6	33.480N	140.084E	SOUTH OF HONSHU JAPAN	101	4.5	0.0	PDE	EQ	ABDE	22:41-23:22	42	20253/ 08
1017	83	05	07	127	23:58:01.9	24.654N	121.959E	TAIWAN	22	4.8	0.0	PDE	EQ	A	00:01-00:12	12	20253/ 09
1018	83	05	08	128	08:26:15.0	36.814N	70.980E	HINDU KUSH REGION	46	4.9	0.0	PDE	EQ	A	08:34-08:45	12	20253/ 10
1019	83	05	08	128	15:05:08.6	19.997N	109.340W	REVILLA GIGEDO ISLANDS REGION	10	5.3	5.8	PDE	EQ	A	15:12-15:23	12	20253/ 11
1020	83	05	08	128	21:30:48.5	43.010N	146.898E	KURIL ISLANDS	33	5.2	0.0	PDE	EQ	ABDE	21:32-22:14	43	20253/ 12
1021	83	05	09	129	15:53:02.7	8.280N	82.925W	PANAMA-COSTA RICA BORDER REGN	36	5.5	6.1	PDE	EQ	AE	16:02-18:11	130	20253/ 13
1022	83	05	09	129	20:09:15.1	19.963N	109.453W	REVILLA GIGEDO ISLANDS REGION	10	5.5	6.2	PDE	EQ	AE	20:16-21:53	98	20254/ 01
1023	83	05	10	130	00:15:06.2	24.422N	121.586E	TAIWAN	33	5.7	5.4	PDE	EQ	A	00:18-00:29	12	20254/ 02
1024	83	05	10	130	01:18:59.2	24.545N	122.029E	TAIWAN REGION	33	5.0	0.0	PDE	EQ	A	01:22-01:33	12	20254/ 03
1025	83	05	10	130	11:02:34.7	5.358S	150.915E	NEW BRITAIN REGION	104	6.0	0.0	PDE	EQ	ABDE	11:03-11:46	44	20254/ 04
1026	83	05	10	130	18:27:30.6	4.793S	152.508E	NEW BRITAIN REGION	60	5.9	0.0	PDE	EQ	ABDE	18:28-19:09	42	20254/ 05
1027	83	05	10	130	18:56:04.8	14.569N	120.352E	LUZON PHILIPPINE ISLANDS	35	5.1	0.0	PDE	EQ	A	18:59-19:10	12	20254/ 05
1028	83	05	10	130	19:05:19.2	36.503N	70.151E	HINDU KUSH REGION	218	5.0	0.0	PDE	EQ	A	19:12-19:24	13	20254/ 06
1029	83	05	11	131	00:17:13.3	2.302N	128.346E	HALMAHERA	140	5.8	0.0	PDE	EQ	A	00:20-00:31	12	20254/ 07
1030	00	00	00	000	00:00:00.0	0.000N	0.000E	UNKNOWN PHASE	0	0.0	0.0	HEL	UN	F	01:04-01:14	11	20254/ 08
1031	83	05	11	131	03:26:50.0	37.211N	141.817E	NEAR E COAST OF HONSHU JAPAN	44	4.8	0.0	PDE	EQ	ABD	03:27-03:42	16	20254/ 09
1032	83	05	11	131	07:41:44.5	11.949N	143.264E	SOUTH OF MARIANA ISLANDS	35	5.3	4.4	PDE	EQ	ABDE	07:42-08:18	37	20254/ 10
1033	83	05	11	131	18:05:06.4	14.726S	167.051E	VANUATU ISLANDS	165	4.8	0.0	PDE	EQ	ABD	18:06-18:23	18	20254/ 11
1034	83	05	11	131	20:20:27.1	45.651N	122.828W	WASHINGTON-OREGON BORDER REGN	0	0.0	0.0	PDE	EQ	A	20:26-20:37	12	20254/ 12
1035	83	05	11	131	21:48:15.2	21.467S	173.461W	TONGA ISLANDS	33	5.9	5.3	PDE	EQ	A	21:51-22:03	13	20254/ 13
1036	83	05	12	132	14:52:02.0	7.072S	103.353E	SOUTHWEST OF SUMATERA	33	5.0	4.7	PDE	EQ	A	14:58-15:09	12	20254/ 14
1037	83	05	12	132	21:52:56.4	51.181N	179.150W	ANDREANOF ISLANDS	50	4.9	0.0	PDE	EQ	ABD	21:54-22:11	18	20254/ 15
1038	83	05	13	133	18:09:37.0	3.020N	128.090E	NORTH OF HALMAHERA	142	5.5	0.0	PDE	EQ	A	18:12-18:23	12	20254/ 16
1039	83	05	13	133	22:54:14.9	6.626S	154.437E	SOLOMON ISLANDS	49	5.0	3.7	PDE	EQ	ABDE	22:55-23:37	43	20254/ 17
1040	83	05	14	134	13:29:17.9	40.393N	139.190E	NEAR W COAST OF HONSHU JAPAN	34	5.1	0.0	PDE	EQ	ABDE	13:30-14:16	47	20255/ 01
1041	83	05	15	135	00:24:00.5	18.888S	175.719W	TONGA ISLANDS	36	5.8	6.5	PDE	EQ	AE	00:27-01:23	57	20255/ 02
1042	83	05	15	135	22:02:14.2	52.022N	179.666E	RAT ISL. ALEUTIAN ISL.	162	4.5	0.0	PDE	EQ	ABD	22:04-22:20	17	20255/ 03
1043	83	05	16	136	12:07:54.7	39.415N	64.324E	UZBEK SSR	33	4.8	0.0	PDE	EQ	A	12:16-12:27	12	20255/ 04
1044	83	05	16	136	16:30:02.8	43.755N	87.293E	NORTHERN XINJIANG CHINA	33	5.0	0.0	PDE	EQ	A	16:36-16:47	12	20255 05
1045	83	05	16	136	21:39:47.1	38.483N	144.530E	OFF E COAST OF HONSHU JAPAN	33	5.1	0.0	PDE	EQ	ABDE	21:40-22:21	42	20255/ 06
1046	83	05	17	137	11:50:24.4	6.636S	154.135E	SOLOMON ISLANDS	59	5.2	0.0	PDE	EQ	ABDE	11:51-12:33	43	20255/ 07
1047	83	05	17	137	20:33:25.3	14.991S	169.040E	VANUATU ISLANDS	51	5.4	4.9	PDE	EQ	ABDE	20:35-21:23	49	20255/-12
1048	83	05	17	137	21:02:13.4	30.683S	177.766W	KERMADEC ISLANDS	33	5.0	0.0	PDE	EQ	A	21:06-21:18	13	20255/-12
1049	83	05	17	137	23:26:33.2	5.432S	153.939E	NEW BRITAIN REGION	118	5.6	0.0	PDE	EQ	ABDE	23:27-00:10	44	20255/ 16
1050	83	05	18	138	07:23:23.6	3.366N	126.799E	TALAUD ISLANDS	33	4.7	0.0	PDE	EQ	A	07:26-07:37	12	20255/ 14
1051	83	05	18	138	08:21:31.4	0.592N	121.739E	MINAHASSA PENINSULA	131	5.3	0.0	PDE	EQ	A	08:25-08:36	12	20255/ 15
1052	83	05	18	138	18:45:24.0	8.359S	121.272E	FLORES ISLAND REGION	209	4.9	0.0	PDE	EQ	A	18:49-19:00	12	20255/ 17
1053	83	05	19	139	09:54:37.9	28.172N	133.122E	RYUKYU ISLANDS	33	4.8	0.0	PDE	EQ	ABD	09:56-10:13	18	20255/ 18
1054	83	05	19	139	17:48:37.0	51.432N	174.078W	ANDREANOF ISL. ALEUTIAN ISL.	39	5.0	0.0	PDE	EQ	ABDE	17:50-18:40	51	20255/ 19
1055	83	05	19	139	21:20:57.0	53.902N	161.299E	OFF EAST COAST OF KAMCHATKA	33	4.4	0.0	PDE	EQ	ABD	21:23-21:39	17	20255/ 20
1056	83	05	20	140	04:45:55.1	4.776S	153.524E	NEW IRELAND REGION	101	4.9	0.0	PDE	EQ	ABD	04:46-05:01	16	20255/ 21
1057	83	05	20	140	06:09:18.0	53.116N	173.641W	ANDREANOF ISL. ALEUTIAN ISL.	233	4.8	0.0	PDE	EQ	ABD	06:11-06:28	16	20255/ 22
1058	83	05	20	140	15:42:06.6	29.291N	132.400E	SOUTHEAST OF SHIKOKU JAPAN	33	4.9	0.0	PDE	EQ	ABD	15:44-15:59	16	20255/ 23
1059	83	05	21	141	09:55:44.7	25.315S	179.319E	SOUTH OF FIJI ISLANDS	550	4.9	0.0	PDE	EQ	A	09:56-10:10	13	20255/ 24
1060	83	05	21	141	10:46:37.0	35.286N	140.246E	NEAR E COAST OF HONSHU JAPAN	31	5.1	4.5	PDE	EQ	ABDE	10:47-11:29	43	20256/ 01
1061	83	05	21	141	18:06:25.2	6.313N	124.268E	MINDANAO PHILIPPINE ISLANDS	71	5.0	0.0	PDE	EQ	A	18:09-18:20	12	20256/ 02
1062	83	05	21	141	18:32:44.5	35.169N	140.377E	NEAR E COAST OF HONSHU JAPAN	33	4.5	0.0	PDE	EQ	ABD	18:33-18:48	16	20256/ 03
1063	83	05	22	142	11:44:19.4	9.378S	123.765E	TIMOR	93	5.0	0.0	PDE	EQ	A	11:48-11:59	12	20256/ 04
1064	83	05	22	142	12:15:19.4	29.897N	141.582E	SOUTH OF HONSHU JAPAN	33	4.8	0.0	PDE	EQ	ABD	12:16-12:32	15	20256/ 05
1065	83	05	22	142	17:02:46.0	13.577S	167.514E	VANUATU ISLANDS	33	5.2	0.0	PDE	EQ	A	17:04-17:15	12	20256/ 05
1066	83	05	22	142	17:13:18.9	45.689N	151.895E	KURIL ISLANDS	33	4.9	0.0	PDE	EQ	ABD	17:14-17:29	16	20256/ 06
1067	83	05	22	142	19:56:12.6	45.133N	146.292E	KURIL ISLANDS	103	4.4	0.0	PDE	EQ	ABD	19:57-20:13	17	20256/ 07
1068	83	05	23	143	06:54:37.9	13.821S	171.294E	VANUATU ISLANDS REGION	38	5.8	5.6	PDE	EQ	A	06:56-07:07	12	20256/ 08
1069	83	05	23	143	17:55:52.9	37.904N	141.945E	NEAR E COAST OF HONSHU JAPAN	33	5.3	5.0	PDE	EQ	ABDE	17:57-18:39	43	20256/ 09
1070	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE HOKKAIDO PO. SO. T	0	0.0	0.0	HEL	EQ	ABDE	05:03-05:47	45	20256/ 10
1071	83	05	24	144	05:09:07.7	24.431N	143.295E	VOLCANO ISLANDS REGION	33	5.1	4.7	PDE	EQ	ABDE	05:09-05:44	36	20256/ 10
1072	83	05	24	144	07:38:36.0	26.910N	140.038E	BONIN ISLANDS REGION	460	4.5	0.0	PDE	EQ	ABD	07:38-07:53	16	20256/ 11
1073	83	05	24	144	10:03:25.0	31.356S	178.541W	KERMADEC ISLANDS REGION	33	5.3	0.0	PDE	EQ	A	10:07-10:19	13	20256/ 12
1074	83	05	24	144	13:39:49.5	55.605N	163.484E	OFF EAST COAST OF KAMCHATKA	49	4.8	0.0	PDE	EQ	ABD	13:42-13:59	18	20256/ 13
1075	83	05	25	145	17:30:58.2	21.912S	130.936W	TUAMOTU ARCHIPELAGO REGION	0	5.9	0.0	PDE	NX	A	17:37-17:48	12	20256/-14
1076	83	05	26	146	03:00:00.6	40.370N	139.153E	NEAR W COAST OF HONSHU JAPAN	33	6.8	7.7	PDE	EQ	ABDE	03:01-03:47	47	20256/-15
1077	83	05	26	146	06:46:03.3	40.930N	139.051E	NEAR W COAST OF HONSHU JAPAN	33	4.6	0.0	PDE	EQ	ABD	06:47-07:03	17	20256/ 16
1078	83	05	26	146	09:35:31.4	41.158N	139.063E	HOKKAIDO JAPAN REGION	19	5.2	0.0	PDE	EQ	ABDE	09:37-10:23	47	20256/ 17
1079	83	05	26	146	10:12:27.3	41.231N	139.097E	HOKKAIDO JAPAN REGION	33	5.3	0.0	PDE	EQ	ABDE	10:14-11:00	47	20256/ 17
1080	83	05	26	146	12:07:14.6	22.417N	101.203E	BURMA-CHINA BORDER REGION	33	4.7	0.0	PDE	EQ	A	12:12-12:24	13	20256/ 18
1081	83	05	26	146	12:18:14.3	39.288N	65.674E	SOUTHEASTERN UZBEK SSR	33	4.8	0.0	PDE	EQ	A	12:26-12:37	12	20256/ 19
1082	83	05	26	146	13:13:23.2	39.574N	140.614E	HONSHU JAPAN	33	5.0	0.0	PDE	EQ	ABDE	13:14-13:59	46	20256/ 20
1083	83	05	26	146	14:12:23.0	40.284N	138.990E	EASTERN SEA OF JAPAN	28	5.6	4.3	PDE	EQ	ABDE	14:14-14:59	46	20257/ 01
1084	83	05	26	146	15:00:00.0	37.103N	116.006W	SOUTHERN NEVADA	0	4.3	0.0	PDE	NX	A	15:06-15:17	12	20257/ 02
1085	83	05	26	146	22:48:24.7	41.012N	139.481E	HOKKAIDO JAPAN REGION	24	5.1	0.0	PDE	EQ	ABDE	22:50-23:36	47	20257/ 03
1086	83	05	26	146	23:25:08.0	40.070N	138.987E	EASTERN SEA OF JAPAN	22	5.0	0.0	PDE	EQ	ABDE	23:26-00:12	47	20257 03
1087	83	05	27	147	04:16:52.3	40.769N	139.097E	NEAR W COAST OF HONSHU JJAPAN	20	5.1	0.0	PDE	EQ	ABDE	04:18-05:04	47	20257/ 04
1088	83	05	27	147	13:35:43.1	46.564N	135.876E	NEAR E COAST OF EASTERN USSR	381	4.6	0.0	PDE	EQ	ABDE	13:37-14:29	53	20257/ 05
1089	83	05	27	147	22:55:39.2	13.866N	120.880E	MINDORO PHILIPPINE ISLANDS	187	5.1	0.0	PDE	EQ	A	22:58-23:10	13	20257/ 06
1090	83	05	28	148	02:29:24.2	41.088N	139.139E	HOKKAIDO JAPAN REGION	20	5.4	4.9	PDE	EQ	ABDE	02:31-03:17	47	20257/ 07
1091	83	05	28	148	06:14:41.1	40.193N	139.968E	EASTERN SEA OF JAPAN	27	4.8	0.0	PDE	EQ	ABD	06:16-06:32	17	20257/ 08
1092	83	05	28	148	07:44:50.9	40.139N	139.390E	NEAR W COAST OF HONSHU JAPAN	33	4.9	0.0	PDE	EQ	ABD	07:46-08:02	17	20257/ 09
1093	83	05	28	148	09:13:35.1	40.931N	139.459E	NEAR W COAST OF HONSHU JAPAN	33	4.3	0.0	PDE	EQ	ABD	09:15-09:31	17	20257/ 10
1094	83	05	28	148	15:48:19.7	40.8[illegible]N	139.163E	NEAR W COAST OF HONSHU JAPAN	33	0.0	0.0	PDE	EQ	ABD	15:50-16:05	16	20257/ 11
1095	83	05	28	148	16:03:37.1	40.38[illegible]N	139.216E	NEAR W COAST OF HONSHU JAPAN	29	5.0	0.0	PDE	EQ	ABDE	16:05-16:50	46	20257/ 11
1096	83	05	28	148	16:10:43.0	40.0[illegible]N	139.0[illegible]E	NEA W COAST OF HONSHU JAPAN	33	5.0	5.0	PDE	EQ	ABDE	16:12-16:58	47	20257/ 11
1097	83	05	28	149	17:49:36.7	1.964S	97.493E	SOUTHERN SUMATERA	26	5.3	4.8	PDE	EQ	A	17:56-18:07	12	20257/ 12
1098	83	05	28	149	19:32:42.1	15.52[illegible]N	121.975E	LUZON PHILIPPINE ISLANDS	33	5.0	0.0	PDE	EQ	A	18:36-18:47	12	20257/ 13
1099	00	00	00	000	[illegible]	0.000N	[illegible]	POSSIBLE MARIANAS PO. SO. T	0	0.0	0.0	HEL	EQ	BDE	23:22-23:51	30	20258/ 01
1100	83	05	28	148	23:54:58.0	6.730S	154.216E	SOLOMON ISLANDS	33	4.6	0.0	PDE	EQ	ABD	23:56-00:11	16	20258/ 02

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 13 AUG 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PJ, C=S, D=SO, E=T, F=OTHER

EVNT NO	YR	MO	DA	JUL	ORIGIN TIME HR:MN:SECS	COORDINATES LAT	COORDINATES LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	MAGNI SRF	INF SRC	EV TP	SAVED PHASES	SAVED INTERVAL	MNS	STRIP TAPE/FILE
1101	83	05	29	149	00:28:32.1	40.398N	139.809E	EASTERN SEA OF JAPAN	33	4.6	4.1	PDE	EQ	ABD	00:38-00:46	17	20256/ 03
1102	83	05	29	149	02:14:22.0	4.223N	122.622E	CELEBES SEA	611	5.5	0.0	PDE	EQ	A	02:17-02:28	12	20256/ 04
1103	83	05	29	149	04:45:39.6	49.255N	155.375E	KURIL ISLANDS	33	5.8	5.2	PDE	EQ	ABDE	04:47-05:32	46	20256/ 05
1104	83	05	29	149	05:26:51.0	36.860N	141.937E	NEAR E COAST OF HONSHU JAPAN	20	5.3	4.1	PDE	EQ	ABDE	05:27-06:09	43	20256/ 05
1105	83	05	29	149	06:55:32.9	40.442N	125.449W	OFF COAST OF NORTH CALIFORNIA	10	5.1	5.1	PDE	EQ	A	07:01-07:12	12	20256/ 06
1106	83	05	29	149	07:15:29.6	40.407N	139.966E	EASTERN SEA OF JAPAN	28	5.1	0.0	PDE	EQ	ABDE	07:17-08:03	47	20256/ 07
1107	83	05	29	149	20:53:57.7	42.715N	141.434E	HOKKAIDO JAPAN REGION	76	5.3	0.0	PDE	EQ	ABDE	20:55-21:40	46	20256/ 08
1108	83	05	29	149	22:01:49.4	40.670N	139.381E	NEAR W COAST OF HONSHU JAPAN	33	5.6	4.7	PDE	EQ	ABDE	22:03-22:49	47	20256/ 09
1109	83	05	29	149	22:07:59.1	15.575S	174.977W	TONGA ISLANDS	302	5.5	0.0	PDE	EQ	A	22:10-22:21	12	20256/ 09
1110	83	05	30	150	02:25:28.5	41.865N	139.163E	HOKKAIDO JAPAN REGION	33	4.6	0.0	PDE	EQ	ABD	02:27-02:43	17	20256/ 10
1111	83	05	30	150	03:33:44.6	49.740N	78.210E	EASTERN KAZAKH SSR	0	5.4	0.0	PDE	NX	A	03:40-03:52	13	20256/ 11
1112	83	05	30	150	12:32:41.1	1.894N	125.549E	MOLUCCA PASSAGE	82	5.4	0.0	PDE	EQ	A	12:36-12:47	12	20256/ 12
1113	83	05	30	150	14:47:14.2	4.727S	103.232E	SOUTHERN SUMATERA	97	5.5	0.0	PDE	EQ	A	14:53-15:04	12	20256/ 13
1114	83	05	30	150	15:54:31.0	52.060N	177.698W	ANDREANOF ISL. ALEUTIAN ISL.	107	5.8	0.0	PDE	EQ	ABDE	15:56-16:45	50	20256/ 14
1115	83	05	31	151	00:17:33.8	40.595N	139.093E	NEAR W COAST OF HONSHU JAPAN	33	4.7	0.0	PDE	EQ	ABD	00:19-00:36	17	20256/ 15
1116	83	05	31	151	00:31:41.8	5.892S	145.572E	EAST OF PAPUA NEW GUINEA REGIO	33	4.7	0.0	PDE	EQ	ABD	00:33-00:49	17	20256/ 15
1117	83	05	31	151	06:18:09.2	4.768S	153.258E	NEW IRELAND REGION	119	4.5	0.0	PDE	EQ	ABD	06:19-06:33	15	20256/ 16
1118	83	05	31	151	21:05:44.1	34.602N	79.764E	KASHMIR-TIBET BORDER REGION	33	5.0	4.3	PDE	EQ	A	21:12-21:24	13	20259/ 01
1119	83	05	31	151	21:15:56.2	40.202N	139.948E	EASTERN SEA OF JAPAN	25	4.9	0.0	PDE	EQ	ABD	21:17-21:33	17	20259/ 01
1120	83	05	31	151	23:19:11.1	40.711N	139.473E	NEAR W COAST OF HONSHU JAPAN	18	5.3	0.0	PDE	EQ	ABDE	23:20-00:06	47	20259/ 02
1121	83	05	31	151	23:22:32.3	40.796N	139.428E	NEAR W COAST OF HONSHU JAPAN	25	5.3	0.0	PDE	EQ	ABDE	23:24-00:10	47	20259/ 02
1122	83	06	01	152	00:58:46.9	40.419N	139.171E	NEAR W COAST OF HONSHU JAPAN	33	4.9	0.0	PDE	EQ	ABD	01:00-01:16	17	20259/ 03
1123	83	06	01	152	01:37:00.7	13.760N	122.748E	MINDORO PHILIPPINE ISLANDS	260	5.5	0.0	PDE	EQ	A	01:40-01:51	12	20259/ 04
1124	83	06	01	152	02:00:00.1	16.996S	174.713W	TONGA ISLANDS	228	6.1	0.0	PDE	EQ	A	02:02-02:13	12	20259/ 05
1125	83	06	01	152	06:40:36.9	39.959N	138.897E	EASTERN SEA OF JAPAN	33	4.8	0.0	PDE	EQ	ABD	06:42-06:58	17	20259/ 06
1126	83	06	01	152	07:14:30.1	40.399N	139.133E	NEAR W COAST OF HONSHU JAPAN	33	4.7	0.0	PDE	EQ	ABD	07:16-07:31	16	20259/ 07
1127	83	06	01	152	07:30:33.9	51.722N	171.302W	FOX ISLANDS ALEUTIAN ISLANDS	33	4.7	0.0	PDE	EQ	ABD	07:33-07:49	17	20259/ 08
1128	83	06	01	152	10:58:42.8	15.922S	172.801W	SAMOA ISLANDS REGION	33	5.6	6.1	PDE	EQ	A	11:01-11:12	12	20259/ 09
1129	83	06	01	152	11:17:40.2	43.919N	80.576E	NORTHERN XINJIANG CHINA	32	5.1	0.0	PDE	EQ	A	11:24-11:35	12	20259/ 10
1130	83	06	01	152	13:13:59.0	17.037S	174.614W	TONGA ISLANDS	223	4.8	0.0	PDE	EQ	A	13:16-13:27	12	20259/ 11
1131	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO, SO, T	0	0.0	0.0	HEL	EQ	BDE	15:29-15:58	30	20259/ 12
1132	00	00	00	000	00:00:00.0	0.000N	0.000E	UNKNOWN P	0	0.0	0.0	HEL	UN	A	20:26-20:35	10	20259/ 13
1133	83	06	02	153	20:51:58.2	24.596S	179.505E	SOUTH OF FIJI ISLANDS	524	5.0	0.0	PDE	EQ	A	20:54-21:06	13	20259/ 14
1134	83	06	03	154	01:30:04.2	51.164N	177.164W	ANDREANOF ISL. ALEUTIAN ISL.	54	4.6	0.0	PDE	EQ	ABD	01:32-01:48	17	20259/ 15
1135	83	06	03	154	21:51:52.4	0.636N	119.917E	MINAHASSA PENINSULA	33	5.0	0.0	PDE	EQ	A	21:56-22:07	12	20259/ 16
1136	83	06	03	154	22:52:13.6	7.094S	129.164E	BANDA SEA	200	5.2	0.0	PDE	EQ	A	22:55-23:06	12	20259/ 17
1137	83	06	04	155	09:34:44.4	27.059N	103.322E	YUNNAN PROVINCE CHINA	33	5.1	0.0	PDE	EQ	A	09:42-09:51	10	20259/ 18
1138	83	06	04	155	11:37:40.9	37.391N	115.214W	SOUTHERN NEVADA	6	0.0	0.0	PDE	EQ	A	11:44-11:55	12	20259/ 19
1139	83	06	05	156	00:43:14.3	7.600S	127.621E	BANDA SEA	184	5.2	0.0	PDE	EQ	A	00:46-00:58	13	20259/ 20
1140	83	06	05	156	05:34:40.2	6.105S	145.100E	EAST PAPUA NEW GUINEA REGION	116	5.2	0.0	PDE	EQ	ABDE	05:36-06:22	47	20259/ 21
1141	83	06	05	156	10:39:38.7	39.235N	75.712E	SOUTHERN XINJIANG CHINA	33	4.9	4.5	PDE	EQ	A	10:47-10:56	12	20259/ 22
1142	83	06	05	156	13:23:34.2	16.098S	172.987W	SAMOA ISLANDS REGION	33	5.1	4.7	PDE	EQ	A	13:26-13:37	12	20259/ 23
1143	83	06	05	156	16:26:40.7	15.929S	173.017W	TONGA ISLANDS	33	5.3	5.1	PDE	EQ	A	16:29-16:40	12	20259/ 24
1144	83	06	05	156	22:17:03.2	39.433N	73.466E	TAJIK-XINJIANG BORDER REGION	33	5.0	0.0	PDE	EQ	A	22:24-22:35	12	20259/ 25
1145	83	06	06	157	03:18:01.4	20.545S	178.569W	FIJI ISLANDS REGION	620	4.9	0.0	PDE	EQ	A	03:20-03:31	12	20259/ 26
1146	83	05	06	157	21:40:17.5	45.365N	150.352E	KURIL ISLANDS	33	5.6	5.1	PDE	EQ	ABDE	21:41-22:24	44	20260/ 01
1147	83	06	07	158	00:11:32.5	23.951N	122.756E	TAIWAN REGION	33	5.1	0.0	PDE	EQ	A	00:14-00:25	12	20260/ 02
1148	83	06	07	158	06:31:34.3	5.433N	95.187E	NORTHERN SUMATERA	110	4.8	0.0	PDE	EQ	A	06:38-06:49	12	20260/ 03
1149	83	06	07	158	15:57:36.1	32.012N	130.921E	KYUSHU JAPAN	51	0.0	4.7	PDE	EQ	ABD	15:59-16:15	17	20260/ 04
1150	83	06	08	159	09:54:38.0	5.289S	102.853E	SOUTHERN SUMATERA	33	5.2	0.0	PDE	EQ	A	10:00-10:12	13	20260/ 05
1151	83	06	09	160	04:36:50.6	40.014N	139.170E	NEAR W COAST OF HONSHU JAPAN	33	4.9	0.0	PDE	EQ	ABD	04:38-04:54	17	20260/ 06
1152	83	05	09	160	04:51:00.7	3.876S	123.046E	CERAM	114	5.2	0.0	PDE	EQ	A	04:54-05:05	12	20260/ 06
1153	83	06	09	160	10:23:31.9	40.198N	139.003E	NEAR W COAST OF HONSHU JAPAN	33	5.4	0.0	PDE	EQ	ABDE	10:25-11:10	46	20260/ 07
1154	83	06	09	160	12:49:04.1	40.200N	139.054E	NEAR W COAST OF HONSHU JAPAN	33	6.3	5.6	PDE	EQ	ABDE	12:50-13:36	47	20260/ 08
1155	83	06	09	160	13:04:00.9	40.193N	139.026E	NEAR W COAST OF HONSHU JAPAN	33	6.3	5.6	PDE	EQ	ABCE	13:05-13:51	47	20260/ 08
1156	83	06	09	160	14:41:29.7	40.403N	137.751E	EASTERN SEA OF JAPAN	33	5.0	0.0	PDE	EQ	ABDE	14:42-15:29	46	20260/ 09
1157	83	05	09	160	17:10:00.0	37.158N	116.089W	SOUTHERN NEVADA	0	4.6	0.0	PDE	NX	A	17:16-17:27	12	20260/ 10
1158	83	06	09	160	18:46:01.0	51.441N	174.161W	ANDREANOF ISL. ALEUTIAN ISL.	20	6.2	5.8	PDE	EQ	ABDE	18:48-19:37	50	20260/ 11
1159	83	06	09	160	20:26:51.0	5.995S	122.650E	SULAWESI	50	5.5	5.2	PDE	EQ	A	20:31-20:42	12	20260/ 12
1160	83	05	09	160	20:36:36.9	51.441N	174.148W	ANDREANOF ISL. ALEUTIAN ISL.	26	4.8	0.0	PDE	EQ	ABD	20:38-20:55	18	20260/ 12
1161	83	05	10	161	02:13:23.0	75.509N	122.682E	LAPTEV SEA	10	5.5	5.3	PDE	EQ	A	02:18-02:30	13	20260/ 13
1162	83	06	10	161	07:20:17.6	40.244N	139.050E	NEAR W COAST OF HONSHU JAPAN	33	5.1	0.0	PDE	EQ	ABDE	07:21-08:07	47	20260/ 14
1163	83	06	10	161	20:38:27.0	16.275N	145.078E	MARIANA ISLANDS	108	5.1	0.0	PDE	EQ	ABDE	20:38-21:10	33	20260/ 15
1164	83	06	10	161	22:39:07.3	24.271S	176.283W	SOUTH OF FIJI ISLANDS	33	5.7	5.4	PDE	EQ	A	22:42-22:54	13	20261/ 01
1165	00	00	00	000	00:00:00.0	0.000N	0.000E	UNKNOWN Po	0	0.0	0.0	HEL	EQ	B	23:26-23:45	20	20261/ 02
1166	83	06	11	162	00:28:13.1	1.615N	126.593E	MOLUCCA PASSAGE	62	5.1	0.0	PDE	EQ	A	00:31-00:42	12	20261/ 03
1167	83	06	11	162	03:09:53.9	36.261N	120.466W	CENTRAL CALIFORNIA	2	5.4	5.4	PDE	EQ	A	03:16-03:27	12	20261/ 04
1168	83	06	11	162	04:54:00.6	4.300S	122.536E	SULAWESI	634	5.3	0.0	PDE	EQ	A	04:57-05:08	12	20261/ 05
1169	83	05	11	162	22:01:26.0	40.712N	139.243E	NEAR W COAST OF HONSHU JAPAN	33	5.0	0.0	PDE	EQ	ABDE	22:03-22:49	47	20261/ 06
1170	83	05	12	163	02:36:43.5	49.894N	78.964E	EASTERN KAZAKH SSR	0	6.1	4.5	PDE	NX	A	02:43-02:55	13	20261/ 07
1171	83	05	12	163	09:14:10.6	12.844S	169.038E	SANTA CRUZ ISLANDS REGION	592	5.2	0.0	PDE	EQ	A	09:15-09:26	12	20261/ 08
1172	83	06	12	163	10:12:43.2	1.527N	127.278E	HALMAHERA	124	5.6	0.0	PDE	EQ	A	10:15-10:26	12	20261/ 09
1173	83	05	12	163	19:20:59.6	46.687N	152.637E	KURIL ISLANDS	33	5.0	0.0	PDE	EQ	ABDE	19:22-20:06	45	20261/ 10
1174	83	06	13	164	00:52:02.2	40.452N	143.885E	OFF E COAST OF HONSHU JAPAN	33	4.7	4.7	PDE	EQ	ABC	00:53-01:08	16	20261/ 11
1175	83	06	13	164	03:54:54.1	45.147N	152.543E	KURIL ISLANDS	33	5.0	0.0	PDE	EQ	ABDE	03:56-04:39	44	20261/ 12
1176	83	06	13	164	04:19:30.5	40.485N	143.701E	OFF E COAST OF HONSHU JAPAN	33	4.9	0.0	PDE	EQ	ABD	04:20-04:35	16	20261/ 12
1177	83	06	13	164	08:01:38.4	27.625N	65.274E	PAKISTAN	33	4.9	0.0	PDE	EQ	A	08:10-08:21	12	20261/ 13
1178	83	06	13	164	09:45:01.1	8.464S	122.633E	FLORES ISLAND REGION	179	5.0	0.0	PDE	EQ	A	09:49-10:00	12	20261/ 14
1179	83	06	14	165	00:59:28.6	53.580S	143.635E	WEST OF MACQUARIE ISLAND	10	5.2	0.0	PDE	EQ	A	01:06-01:17	12	20261/ 15
1180	83	06	15	166	06:05:55.5	34.189N	92.817E	QINGHAI PROVINCE CHINA	33	5.1	5.2	PDE	EQ	A	06:12-06:23	12	20261/ 16
1181	83	06	15	166	06:07:55.3	15.192S	173.686W	TONGA ISLANDS	40	5.5	5.5	PDE	EQ	A	06:10-06:22	13	20261/ 16
1182	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS Po. So. T.	0	0.0	0.0	HEL	EQ	BDE	07:21-07:50	30	20261/ 17
1183	83	06	15	166	07:33:43.6	5.307N	127.592E	PHILIPPINE ISLANDS REGION	53	5.4	5.0	PDE	EQ	A	07:36-07:47	12	20261/ 17
1184	83	06	15	166	13:34:06.5	39.320N	64.333E	UZBEK SSR	33	4.9	0.0	PDE	EQ	A	13:42-13:53	12	20261/ 18
1185	83	06	17	168	11:33:15.4	36.448S	97.443W	WEST CHILE RISE	10	5.5	5.5	PDE	EQ	A	11:42-12:01	20	20261/ 19
1186	83	05	17	168	20:55:32.6	41.283N	139.155E	HOKKAIDO JAPAN REGION	33	5.0	0.0	PDE	EQ	ABDE	20:57-21:43	47	20261/ 20
1187	83	06	17	168	22:02:31.6	52.234N	159.647E	OFF E COAST OF KAMCHATKA	33	5.6	5.0	PDE	EQ	ABDE	22:04-22:52	45	20262/ 01
1188	83	05	18	169	03:03:34.0	53.121N	155.748E	NEAR EAST COAST OF KAMCHATKA	33	5.0	0.0	PDE	EQ	ABDE	03:05-03:54	50	20262/ 02
1189	83	06	18	169	11:29:48.4	5.577S	131.260E	BANDA SEA	59	5.1	0.0	PDE	EQ	A	11:33-11:44	12	20262/ 03
1190	83	06	18	169	13:17:56.2	12.255N	143.004E	SOUTH OF MARIANA ISLANDS	52	4.9	0.0	PDE	EQ	ABD	13:16-13:31	14	20262/ 04
1191	83	05	18	169	19:31:12.7	0.247S	155.350E	SOLOMON ISLANDS	27	5.5	0.0	PDE	EQ	ABDE	19:32-20:15	44	20262/ 05
1192	83	06	18	169	21:29:33.5	33.517N	131.793E	KYUSHU JAPAN	71	5.1	0.0	PDE	EQ	ABDE	21:31-22:19	49	20262/ 06
1193	83	05	18	169	22:13:31.4	40.129N	133.965E	EASTERN SEA OF JAPAN	22	5.5	4.7	PDE	EQ	ABCE	22:15-23:00	46	20262/ 06
1194	83	06	19	170	04:35:50.7	40.086N	139.947E	EASTERN SEA OF JAPAN	33	4.9	0.0	PDE	EQ	ABD	04:37-04:53	17	20262/ 07
1195	83	05	19	170	05:45:16.7	16.584S	175.059W	TONGA ISLANDS	310	4.8	0.0	PDE	EQ	A	06:47-06:59	13	20262/ 08
1196	83	05	19	170	21:38:15.8	40.83[illegible]N	144.844E	OFF E COAST OF HONSHU JAPAN	33	4.9	0.0	PDE	EQ	ABD	21:39-21:54	16	20262/ 09
1197	83	0[illegible]	20	171	02:43:25.6	40.963N	[illegible]	NEAR W COAST OF HONSHU JAPAN	25	5.3	4.5	PDE	EQ	ABDE	02:45-03:31	47	20262/ 10
1198	83	0[illegible]	20	171	05:43:33.2	23.536S	[illegible]	SOUTH OF FIJI ISLANDS	548	5.6	0.0	PDE	EQ	A	05:46-05:57	1[illegible]	20262/ 11
1199	83	05	20	171	15:14:32.2	44.577N	14[illegible].646E	KURIL ISLANDS	78	5.3	0.0	PDE	EQ	ABDE	15:15-15:59	45	20262/ 12
1200	83	05	21	172	03:44:49.4	17.473S	169.484E	VANUATU ISLANDS	281	5.1	0.0	PDE	EQ	A	03:46-03:58	13	20262/ 13

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                    WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING                 13 AUG 83

     KEY:  INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
                    EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
                        PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT ******ORIGIN TIME****** **COORDINATES*** ***********LOCATION*********** DEP *MAGNI* INF EV ********SAVED********* **STRIP**
*NO* YR*MO*DA*JUL*HR*MN*SECS **LAT*****LON*** **********DESCRIPTION********* KM* BDY*SRF SRC TP PHASES**INTERVAL***MNS TAPE/FILE

1201 83 06 21 172 06:25:27.6 41.315N 139.136E HOKKAIDO JAPAN REGION             13 6.6 6.0 PDE EQ ABDE   06:27-07:13  47 20063/ 01
1202 83 06 21 172 06:46:50.1 41.305N 139.345E HOKKAIDO JAPAN REGION             33 5.4 0.0 PDE EQ ABDE   06:48-07:34  47        0/ 00
1203 83 06 21 172 07:04:22.2 41.350N 139.349E HOKKAIDO JAPAN REGION             33 5.5 0.0 PDE EQ ABDE   07:06-07:52  47        0/ 00
1204 83 06 21 172 07:13:51.4 41.320N 139.270E HOKKAIDO JAPAN REGION             33 5.4 0.0 PDE EQ ABDE   07:15-08:01  47        0/ 00
1205 83 06 21 172 09:12:15.3 41.300N 139.596E HOKKAIDO JAPAN REGION             33 4.6 0.0 PDE EQ ABD    09:13-09:29  17        0/ 00
1206 83 06 21 172 10:16:05.7 41.380N 139.421E HOKKAIDO JAPAN REGION             33 4.8 0.0 PDE EQ ABD    10:17-10:33  17        0/ 00
1207 83 06 21 172 10:26:28.8  5.483S 151.037E NEW BRITAIN REGION               105 5.2 0.0 PDE EQ ABDE   10:27-11:10  44        0/ 00
1208 83 06 21 172 10:38:46.7 24.045N 122.853E TAIWAN REGION                     33 4.9 0.0 PDE EQ A      10:41-10:53  13        0/ 00
1209 83 06 21 172 11:29:55.5 41.735N 139.168E HOKKAIDO JAPAN REGION             20 5.2 0.0 PDE EQ ABDE   11:31-12:18  46        0/ 00
1210 83 06 21 172 11:32:12.7  7.122S 129.983E BANDA SEA                        111 4.8 0.0 PDE EQ A      11:35-11:46  12        0/ 00
1211 83 06 21 172 11:36:57.5 15.436S 173.451W TONGA ISLANDS                     33 5.1 0.0 PDE EQ A      11:39-11:51  13        0/ 00
1212 83 06 21 172 14:31:50.9 24.077N 122.467E TAIWAN REGION                     32 5.3 4.7 PDE EQ A      14:34-14:46  13        0/ 00
1213 83 06 21 172 14:48:05.5 24.253N 122.488E TAIWAN REGION                     24 5.8 6.3 PDE EQ A      14:51-15:02  12        0/ 00
1214 83 06 21 172 15:49:41.9  6.260N 125.335E MINDANAO PHILIPPINE ISLANDS      342 0.0 0.0 PDE EQ A      15:52-16:03  12        0/ 00
1215 83 06 21 172 16:02:21.3 41.521N 139.488E HOKKAIDO JAPAN REGION             33 4.8 0.0 PDE EQ ABD    16:04-16:20  17        0/ 00
1216 83 06 21 172 17:06:52.1 29.705N 129.362E RYUKYU ISLANDS                   164 5.9 0.0 PDE EQ ABDE   17:06-17:56  51        0/ 00
1217 83 06 22 173 04:34:20.8 41.378N 139.277E HOKKAIDO JAPAN REGION             33 5.0 0.0 PDE EQ ABDE   04:36-05:22  47        0/ 00
1218 83 06 22 173 04:36:34.3 41.047N 139.161E HOKKAIDO JAPAN REGION             27 5.3 0.0 PDE EQ ABDE   04:38-05:24  47        0/ 00
1219 83 06 22 173 05:39:33.9 41.455N 139.381E HOKKAIDO JAPAN REGION             33 4.8 0.0 PDE EQ ABD    05:41-05:57  17        0/ 00
1220 83 06 22 173 14:32:07.4 50.315N 142.257E SAKHALIN ISLAND                   33 4.8 0.0 PDE EQ ABD    14:34-14:51  18        0/ 00
1221 83 06 22 173 15:20:23.4 41.340N 139.224E HOKKAIDO JAPAN REGION             18 5.1 0.0 PDE EQ ABDE   15:22-16:08  47        0/ 00
1222 83 06 22 173 20:15:46.0 40.033N 138.974E EASTERN SEA OF JAPAN              17 5.3 4.1 PDE EQ ABDE   20:17-21:03  47        0/ 00
1223 83 06 22 173 21:38:27.0 41.165N 139.335E HOKKAIDO JAPAN REGION             33 4.4 0.0 PDE EQ ABD    21:40-21:56  17        0/ 00
1224 83 06 23 174 01:45:03.5 51.366N 179.024W ANDREANOF ISL. ALEUTIAN ISL.      33 4.8 0.0 PDE EQ ABD    01:47-02:03  17        0/ 00
1225 83 06 23 174 11:00:39.0 41.556N 141.956E HOKKAIDO JAPAN REGION             79 4.9 0.0 PDE EQ ABD    11:02-11:17  16        0/ 00
1226 83 05 23 174 12:05:16.4 51.763N 139.599E SOUTH OF AUSTRALIA                10 5.5 5.6 PDE EQ A      12:08-12:19  12        0/ 00
1227 83 06 23 174 19:40:23.1 26.760S 177.171W SOUTH OF FIJI ISLANDS             54 5.0 4.8 PDE EQ A      19:44-19:55  12        0/ 00
1228 83 06 24 175 02:09:28.8  4.669S 102.562E SOUTHERN SUMATERA                 33 5.1 0.0 PDE EQ A      02:15-02:26  12        0/ 00
1229 83 06 24 175 07:18:21.9 21.723N 103.381E SOUTHEAST ASIA                    18 6.1 6.5 PDE EQ F      07:16-08:47  90        0/ 00
1230 83 06 24 175 09:06:46.7 24.197N 122.439E TAIWAN REGION                     54 6.0 0.0 PDE EQ A      09:09-09:21  13        0/ 00
1231 83 06 24 175 09:07:17.2 45.155N 146.921E KURIL ISLANDS                     97 4.9 0.0 PDE EQ ABD    09:08-09:24  17        0/ 00
1232 83 06 24 175 12:20:14.6 34.435N  69.609E AFGHANISTAN                       33 4.7 0.0 PDE EQ A      12:28-12:39  12        0/ 00
1233 83 06 24 175 19:55:20.9 23.993N 122.696E TAIWAN REGION                     33 5.0 0.0 PDE EQ A      19:56-20:09  12        0/ 00
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1234 83 06 25 176 02:33:41.3 29.898S 177.351W KERMADEC ISLANDS                  33 5.1 0.0 PDE EQ A      02:38-02:49  12 22264--9
1235 83 06 25 176 10:03:17.6 32.804S 178.798W SOUTH OF KERMADEC ISLANDS         46 5.6 5.6 PDE EQ A      10:07-10:19  13 22264-11
1236 83 06 25 176 11:59:45.6 18.858S 177.589W FIJI ISLANDS REGION              595 5.1 0.0 PDE EQ A      12:01-12:13  13 22264-12
1237 83 06 25 176 13:50:25.3 32.277N 137.683E SOUTH OF HONSHU JAPAN            377 5.1 0.0 PDE EQ ABDE   13:51-14:34  44 22264-14
1238 83 06 25 176 08:40:43.0  1.332N  99.918E NORTHERN SUMATERA                205 4.9 0.0 PDE EQ A      08:46-08:57  12 22264-10
1239 83 06 25 176 14:12:54.9 23.103N 123.343E SOUTHWESTERN RYUKYU ISLANDS       16 5.4 0.0 PDE EQ A      14:15-14:27  13 22264-14
1240 83 06 25 176 15:04:09.9 22.037S 177.465W SOUTH OF FIJI ISLANDS            274 5.5 0.0 PDE EQ A      15:07-15:18  12 22264-13
1241 83 06 25 176 19:10:02.2 32.817S 178.679W SOUTH OF KERMADEC ISLANDS         33 5.5 0.0 PDE EQ A      19:14-19:26  13 22264-15
1242 83 06 25 176 19:40:55.3 24.001N 122.550E TAIWAN REGION                     42 5.5 5.0 PDE EQ A      19:44-19:55  12 22264-16
1243 83 06 25 176 23:14:56.8  7.291S 106.017E JAVA                              56 5.2 0.0 PDE EQ A      23:21-23:32  12 22264-17
1244 83 06 26 177 02:31:16.2 23.005N  93.758E BURMA-INDIA BORDER REGION         73 4.7 0.0 PDE EQ A      02:37-02:48  12 22264-18
1245 83 06 26 177 05:10:20.1 44.931S 167.277E SOUTH ISLAND NEW ZEALAND          33 5.1 0.0 PDE EQ A      05:16-05:27  12 22264-**
1246 83 06 26 177 13:56:54.5 41.381N 139.386E HOKKAIDO JAPAN REGION             29 4.9 0.0 PDE EQ ABD    13:58-14:14  17 22264-20
1247 83 06 26 177 15:54:23.5 17.855S 167.470E VANUATU ISLANDS                   45 5.2 5.2 PDE EQ A      15:56-16:09  13 22264-21
1248 83 06 26 177 17:45:11.1 28.893N 139.894E BONIN ISLANDS REGION             281 4.9 0.0 PDE EQ ABDE   17:45-18:25  41 22265- 1
1249 83 06 27 178 00:25:13.2 18.100S 167.666E VANUATU ISLANDS                   58 5.0 0.0 PDE EQ A      06:27-06:39  13 22265- 2
1250 83 06 27 178 14:10:05.5 23.847S 179.955W SOUTH OF FIJI ISLANDS            540 5.3 0.0 PDE EQ A      14:12-14:24  13 22265- 3
1251 83 06 28 179 03:25:16.6 60.250N 141.272W SOUTHEASTERN ALASKA               15 5.9 5.4 PDE EQ ABDE   03:30-04:40  71 22265--4
1252 83 06 28 179 17:45:58.2 21.815S 138.950W TUAMOTU ARCHIPELAGO REGION         0 5.4 0.0 PDE NX A      17:52-18:03  12 22265- 5
1253 83 06 28 179 21:55:46.1 22.734S 174.702W TONGA ISLANDS REGION              33 5.2 4.9 PDE EQ A      21:59-22:10  12 22265- 6
1254 83 06 28 179 23:59:33.4 43.874N  84.075E NORTHERN XINJIANG CHINA           33 5.1 4.5 PDE EQ A      00:06-00:17  12 22265- 7
1255 83 06 29 180 05:11:57.3 40.190N 139.022E NEAR W COAST OF HONSHU JAPAN      33 5.1 0.0 PDE EQ ABDE   05:13-05:59  47 22265- 8
1256 83 06 29 180 10:55:40.6 36.632N 140.794E NEAR E COAST OF HONSHU JAPAN     103 4.6 0.0 PDE EQ ABD    10:56-11:11  16 22265- 9
1257 83 06 29 180 12:51:37.9  6.916S 129.021E BANDA SEA                        193 4.2 0.0 PDE EQ A      12:55-13:06  12 22265-10
1258 00 00 00 000 00:00:00.0  0.002N   0.000E PROBABLE BONIN ISL. PO.SO.T        0 0.0 0.0 HEL EQ BDE    16:14-16:53  40 22265-11
1259 83 06 29 180 22:18:22.6 41.277N 139.358E HOKKAIDO JAPAN REGION             33 4.9 0.0 PDE EQ ABD    22:20-22:36  17 22265-12
1260 83 06 30 181 06:53:28.7 18.871N 121.313E LUZON PHILIPPINE ISLANDS          75 5.1 0.0 PDE EQ A      06:56-07:07  12 22265-13
1261 83 06 30 181 13:39:04.5 44.032N 147.849E KURIL ISLANDS                     47 5.6 5.4 PDE EQ ABDE   13:40-14:23  44 22265-14
1262 83 06 30 181 14:11:23.2 18.540S 174.841W TONGA ISLANDS                    272 4.8 0.0 PDE EQ A      14:14-14:25  12 22265-14
1263 83 06 30 181 17:37:49.0  2.529N 128.265E HALMAHERA                         49 5.6 5.4 PDE EQ A      17:40-17:52  13 22265-15
1264 83 06 30 181 18:24:51.5 44.402N 149.519E KURIL ISLANDS                     33 5.3 5.1 PDE EQ ABDE   18:26-19:08  43 22266- 1
1265 83 06 30 181 23:03:58.1  6.910S 155.220E SOLOMON ISLANDS                   97 5.1 0.0 PDE EQ ABDE   23:05-23:46  42 22266- 2
1266 83 06 30 181 23:18:51.0 44.428N 149.498E KURIL ISLANDS                     48 5.1 0.0 PDE EQ ABDE   23:20-00:02  43 22266- 2
1267 83 06 30 181 23:42:16.9 44.318N 149.586E KURIL ISLANDS                     33 5.0 0.0 PDE EQ ABDE   23:43-00:26  44 22266- 2
1268 83 07 01 182 02:23:11.7 44.523N 149.410E KURIL ISLANDS                     60 5.4 0.0 PDE EQ ABDE   02:24-03:07  44 22266- 3
1269 83 07 01 182 06:35:56.0 32.262N 140.464E SOUTH OF HONSHU JAPAN             76 4.8 0.0 PDE EQ ABD    06:36-06:51  16 22266- 4
1270 83 07 01 182 08:53:55.5 44.256N 149.580E KURIL ISLANDS                     33 5.0 4.0 PDE EQ ABDE   08:55-09:[illegible]  43 22266- 5
1271 83 07 01 182 10:46:54.7 44.374N 149.575E KURIL ISLANDS                     33 5.2 4.7 PDE EQ ABDE   10:48-11:30  43 22266- 6
1272 83 07 01 182 22:03:42.0 36.898N 141.057E NEAR E COAST OF HONSHU JAPAN      53 5.5 0.0 PDE EQ ABDE   22:04-22:47  44 22266- 7
1273 83 07 01 182 23:32:00.4 39.961N 139.016E NEAR W COAST OF HONSHU JAPAN      37 4.6 0.0 PDE EQ ABD    23:33-23:49  17 22266- 8
1274 83 07 02 183 05:32:42.6 40.060N 138.965E EASTERN SEA OF JAPAN              33 5.1 0.0 PDE EQ ABDE   05:34-06:20  47 22267- 1
1275 00 00 00 000 00:00:00.0  0.002N   0.000E UNKNOWN PO                         0 0.0 0.0 HEL EQ B      07:10-07:47  30 22267- 2
1276 83 07 02 183 09:34:05.6  5.724N  94.779E NORTHERN SUMATERA                 98 5.7 0.0 PDE EQ A      09:40-09:51  12 22267- 3
1277 83 07 02 183 11:42:21.9 39.305N  64.301E UZBEK SSR                         33 4.9 0.0 PDE EQ A      11:50-12:01  12 22267- 4
1278 83 07 03 184 02:49:26.8 20.157N 122.418E PHILIPPINE ISLANDS REGION        211 6.1 0.0 PDE EQ A      02:52-03:03  12 22267- 5
1279 83 07 03 184 06:11:35.7  5.589S 154.318E SOLOMON ISLANDS                  405 5.4 0.0 PDE EQ ABDE   06:12-06:53  42 22267- 6
1280 83 07 03 184 07:05:26.1 41.453N 139.347E HOKKAIDO JAPAN REGION             33 5.0 0.0 PDE EQ ABDE   07:07-07:53  47 22267- 7
1281 83 07 03 184 08:01:22.0 13.893S 167.954E VANUATU ISLANDS                   33 4.9 0.0 PDE EQ A      08:03-08:14  12 22267- 8
1282 83 07 03 184 17:14:23.2  9.650N  83.644W COSTA RICA                        33 5.7 6.1 PDE EQ AE     17:23-19:31 129 22267- 9
1283 83 07 03 184 17:40:01.4 24.823N 141.012E VOLCANO ISLANDS REGION           292 4.5 0.0 PDE EQ ABDE   17:48-18:26  39 22267- 9
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WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 27 SEP 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT NO	ORIGIN TIME YR	MO	DA	JUL	HR:MN:SECS	COORDINATES LAT	LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	SRF	INF SRC	EV TP	PHASES	SAVED INTERVAL	STRIP MNS	TAPE-FIL
1284	83	07	03	184	20:24:41.5	24.372N	122.499E	TAIWAN REGION	65	5.2	0.0	PDE	EQ	A	20:27-20:39	13	20068- 1
1285	83	07	04	185	11:32:46.2	55.569S	27.942W	SOUTH SANDWICH ISLANDS REGION	33	5.5	4.6	PDE	EQ	A	11:42-12:01	20	20068- 2
1286	83	07	04	185	20:51:19.6	49.753N	155.610E	KURIL ISLANDS	48	5.0	0.0	PDE	EQ	ABDE	20:52-21:38	47	20068- 3
1287	83	07	04	185	22:00:34.0	4.415N	126.736E	TALAUD ISLANDS	100	5.1	0.0	PDE	EQ	A	22:03-22:14	12	20068- 4
1288	83	07	05	186	05:58:21.4	55.696S	123.453W	EASTER ISLAND CORDILLERA	10	5.3	6.0	PDE	EQ	AE	06:07-08:03	117	20068- 5
1289	83	07	05	186	08:54:48.8	26.431N	128.947E	RYUKYU ISLANDS	33	5.3	5.1	PDE	EQ	ABDE	08:57-09:46	50	20068- 6
1290	83	07	05	186	09:57:38.0	24.201S	174.894W	SOUTH OF TONGA ISLANDS	33	5.5	0.0	PDE	EQ	A	10:01-10:12	12	20068- 7
1291	83	07	05	186	11:11:41.1	22.551S	171.015E	LOYALTY ISLANDS REGION	45	6.0	6.4	PDE	EQ	AE	11:14-12:11	58	20068- 8
1292	83	07	05	186	11:49:02.8	22.718S	170.931E	LOYALTY ISLANDS REGION	51	5.1	0.0	PDE	EQ	A	11:52-12:03	12	20068- 8
1293	83	07	05	186	12:55:05.0	22.713S	171.040E	LOYALTY ISLANDS REGION	33	5.4	0.0	PDE	EQ	A	12:58-13:09	12	20068- 9
1294	83	07	05	186	16:37:06.0	57.821S	25.629W	SOUTH SANDWICH ISLANDS REGION	33	5.7	5.5	PDE	EQ	A	16:46-17:05	20	20069- 1
1295	83	07	06	187	03:24:15.4	22.921S	171.061E	LOYALTY ISLANDS REGION	33	5.2	0.0	PDE	EQ	A	03:27-03:38	12	20069- 2
1296	83	07	06	187	04:54:36.5	21.807S	174.022W	TONGA ISLANDS	40	5.3	5.0	PDE	EQ	A	04:58-05:09	12	20069- 3
1297	83	07	06	187	07:47:12.8	13.812N	144.759E	MARIANA ISLANDS	146	5.0	0.0	PDE	EQ	ABDE	07:47-08:21	35	20069- 4
1298	83	07	06	187	17:59:54.7	11.630S	166.347E	SANTA CRUZ ISLANDS	33	5.2	4.8	PDE	EQ	A	18:01-18:12	12	20069- 5
1299	83	07	06	187	18:19:31.7	1.715N	98.148E	NORTHERN SUMATERA	84	5.3	0.0	PDE	EQ	A	18:25-18:37	13	20069- 6
1300	00	00	00	000	00:00:00.0	0.000N	0.000E	UNKNOWN PO, SO, T	0	0.0	0.0	HEL	EQ	BDE	00:48-01:27	40	20069- 7
1301	83	07	07	188	01:02:57.8	22.633S	171.000E	LOYALTY ISLANDS REGION	55	5.3	5.0	PDE	EQ	A	01:06-01:17	12	20069- 7
1302	83	07	07	188	03:35:05.5	12.203N	125.749E	SAMAR PHILIPPINE ISLANDS	40	5.0	0.0	PDE	EQ	A	03:38-03:49	12	20069- 8
1303	83	07	07	188	05:29:48.4	22.613S	170.858E	LOYALTY ISLANDS REGION	64	5.1	0.0	PDE	EQ	A	05:32-05:44	13	20069- 9
1304	83	07	07	188	13:33:53.5	19.203S	177.301W	FIJI ISLANDS REGION	377	5.3	0.0	PDE	EQ	A	13:36-13:47	12	20069-10
1305	83	07	07	188	15:35:45.4	22.602S	170.961E	LOYALTY ISLANDS REGION	33	5.1	0.0	PDE	EQ	A	15:38-15:50	13	20069-11
1306	83	07	07	188	16:05:40.8	22.561S	170.722E	LOYALTY ISLANDS REGION	41	5.4	6.2	PDE	EQ	AE	16:08-17:05	56	20069-12
1307	83	07	08	189	00:58:11.7	2.398N	128.424E	HALMEHERA	157	5.3	0.0	PDE	EQ	A	01:01-01:12	12	20069-13
1308	83	07	08	189	10:05:00.1	21.820S	173.380W	TONGA ISLANDS	33	5.5	4.8	PDE	EQ	A	10:08-10:19	12	20070- 1
1309	83	07	08	189	13:38:12.1	19.472S	169.070E	VANUATU ISLANDS	152	5.2	0.0	PDE	EQ	A	13:40-13:52	13	20070- 2
1310	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO, SO, T	0	0.0	0.0	HEL	EQ	BDE	14:38-15:07	30	20070- 3
1311	83	07	09	190	18:30:39.0	6.432S	146.625E	EAST PAPUA NEW GUINEA REGION	110	5.1	0.0	PDE	EQ	ABDE	18:32-19:10	47	20070- 4
1312	83	07	10	191	03:59:57.0	51.327N	53.286E	EUROPEAN USSR	0	5.3	0.0	PDE	NX	A	04:06-04:19	12	20070- 5
1313	83	07	10	191	04:04:57.0	51.336N	53.290E	EUROPEAN USSR	0	5.4	0.0	PDE	NX	A	04:13-04:24	12	20070- 5
1314	83	07	10	191	04:09:57.1	51.357N	53.321E	EUROPEAN USSR	0	5.2	0.0	PDE	NX	A	04:18-04:29	12	20070- 5
1315	83	07	10	191	17:19:46.6	27.401N	128.306E	RYUKYU ISLANDS	58	5.4	0.0	PDE	EQ	A	17:22-17:33	12	20070- 6
1316	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO,SO,,T	0	0.0	0.0	HEL	EQ	BDE	01:01-01:30	32	20070- 7
1317	83	07	11	192	10:35:26.0	41.340N	139.495E	HOKKAIDO JAPAN REGION	33	4.6	0.0	PDE	EQ	ABD	10:37-10:53	17	20070- 8
1318	83	07	11	192	12:56:28.1	60.896S	52.935W	SOUTH SHETLAND ISLANDS	10	6.1	6.9	PDE	EQ	AE	13:05-15:45	161	20070- 9
1319	83	07	11	192	21:10:23.0	40.522N	77.625E	KIRGHIZ-XINJIANG BORDER REGION	33	5.0	0.0	PDE	EQ	A	21:25-21:36	12	20070-10
1320	83	07	12	193	14:56:55.3	38.033N	141.095E	NEAR E COAST OF HONSHU JAPAN	33	4.7	0.0	PDE	EQ	ABD	14:56-15:13	16	20070-11
1321	83	07	12	193	15:10:03.3	61.033N	147.379W	SOUTHERN ALASKA	37	6.1	6.3	PDE	EQ	ABDE	15:14-16:22	69	20070-11
1322	83	07	13	194	11:09:42.2	36.320N	70.991E	HINDU KUSH REGION	131	4.7	0.0	PDE	EQ	A	11:17-11:26	12	20070-12
1323	83	07	13	194	15:07:40.8	6.623S	106.340E	JAVA	127	5.0	0.0	PDE	EQ	A	15:13-15:24	12	20071- 1
1324	83	07	14	195	09:48:36.8	18.957S	175.699W	TONGA ISLANDS	275	5.1	0.0	PDE	EQ	A	09:51-10:02	12	20071- 2
1325	83	07	14	195	19:47:46.5	5.532N	126.466E	MINDANAO PHILIPPINE ISLANDS	43	5.6	6.0	PDE	EQ	AE	19:50-20:46	57	20071- 3
1326	83	07	15	196	03:18:03.1	18.965S	168.363E	VANUATU ISLANDS	33	5.1	0.0	PDE	EQ	A	03:20-03:32	13	20071- 4
1327	83	07	15	196	03:55:53.9	52.288N	176.913W	ANDREANOF ISL. ALEUTIAN ISL.	127	5.2	0.0	PDE	EQ	ABDE	03:57-04:47	51	20071- 5
1328	83	07	15	196	04:46:56.5	21.799N	103.425E	SOUTHEAST ASIA	33	5.0	5.0	PDE	EQ	A	04:54-05:05	12	20071- 6
1329	83	07	15	196	07:48:59.4	60.282N	140.897W	SOUTHEASTERN ALASKA	15	5.1	0.0	PDE	EQ	A	07:53-08:05	13	20071- 7
1330	83	07	15	196	10:39:08.3	23.005N	121.439E	TAIWAN	36	5.0	0.0	PDE	EQ	A	10:42-10:53	12	20071- 8
1331	83	07	15	196	10:45:38.2	5.465N	126.540E	MINDANAO PHILIPPINE ISLANDS	47	5.6	5.6	PDE	EQ	A	10:48-10:59	12	20071- 8
1332	83	07	16	197	02:32:16.0	5.495N	126.538E	MINDANAO PHILIPPINE ISLANDS	30	5.2	5.2	PDE	EQ	A	02:35-02:46	12	20072-20
1333	83	07	16	197	07:55:24.6	7.186S	129.361E	BANDA SEA	150	5.4	0.0	PDE	EQ	A	07:58-08:10	13	20071-10
1334	83	07	16	197	11:25:11.7	7.784S	126.744E	BANDA SEA	176	5.2	0.0	PDE	EQ	A	11:28-11:40	13	20071-11
1335	83	07	16	197	14:09:47.5	0.156S	121.706E	MINAHASSA PENINSULA	71	5.2	0.0	PDE	EQ	A	14:13-14:24	12	20071-12
1336	83	07	16	197	15:50:07.3	18.901S	177.556E	FIJI ISLANDS	11	5.0	4.4	PDE	EQ	A	15:52-16:04	13	20071-13
1337	83	07	16	197	17:19:22.2	44.876N	140.871E	EASTERN SEA OF JAPAN	246	4.8	0.0	PDE	EQ	ABDE	17:20-18:08	49	20071-14
1338	83	07	16	197	18:17:11.4	0.141S	121.664E	MINAHASSA PENINSULA	49	5.0	0.0	PDE	EQ	A	18:21-18:32	12	20071-15
1339	83	07	16	197	23:28:22.7	7.418S	108.323E	JAVA	130	4.9	0.0	PDE	EQ	A	23:34-23:45	12	20071-16
1340	83	07	17	198	01:33:40.1	0.104S	121.679E	MINAHASSA PENINSULA	54	5.0	0.0	PDE	EQ	A	01:37-01:48	12	20071-17
1341	83	07	17	198	01:56:52.8	49.238N	155.669E	KURIL ISLANDS	96	5.0	0.0	PDE	EQ	ABDE	01:58-02:43	46	20071-18
1342	83	07	17	198	05:22:52.8	5.379N	126.555E	MINDANAO PHILIPPINE ISLANDS	45	5.3	4.1	PDE	EQ	A	05:26-05:37	12	20071-19
1343	83	07	17	198	05:44:45.5	0.115S	121.669E	MINAHASSA PENINSULA	54	5.2	0.0	PDE	EQ	A	05:48-05:59	12	20071-20
1344	83	07	17	198	06:29:19.8	18.479S	177.784W	FIJI ISLANDS REGION	591	5.1	0.0	PDE	EQ	A	06:31-06:42	12	20071-21
1345	93	07	17	198	10:14:26.1	0.056S	121.727E	MINAHASSA PENINSULA	51	5.2	0.0	PDE	EQ	A	10:18-10:29	12	20071-22
1346	83	07	17	198	10:21:54.0	7.144S	129.546E	BANDA SEA	103	4.9	0.0	PDE	EQ	A	10:25-10:36	12	20071-22
1347	83	07	17	198	13:15:52.6	0.024S	121.771E	MINAHASSA PENINSULA	33	5.0	0.0	PDE	EQ	A	13:19-13:31	13	20071-23
1348	83	07	17	198	14:47:05.6	23.508S	179.051E	SOUTH OF FIJI ISLANDS	554	5.0	0.0	PDE	EQ	A	14:49-15:01	13	20072- 1
1349	83	07	17	198	16:01:54.1	0.083S	121.763E	MINAHASSA PENINSULA	52	5.2	0.0	PDE	EQ	A	16:05-16:17	13	20072- 2
1350	83	07	17	198	19:04:19.3	0.081S	121.740E	MINAHASSA PENINSULA	62	5.4	0.0	PDE	EQ	A	19:08-19:19	12	20072- 3
1351	83	07	17	198	21:06:24.7	36.335N	70.838E	HINDU KUSH REGION	216	4.9	0.0	PDE	EQ	A	21:13-21:25	13	20072- 4
1352	83	07	17	198	21:56:21.4	31.256S	178.283W	KERMADEC ISLANDS REGION	87	5.3	0.0	PDE	EQ	A	22:00-22:12	13	20072- 5
1353	83	07	17	198	22:10:23.1	0.079S	121.689E	MINAHASSA PENINSULA	49	5.4	0.0	PDE	EQ	A	22:14-22:25	12	20072- 6
1354	83	07	17	198	23:02:49.7	22.787S	178.130W	SOUTH OF FIJI ISLANDS	335	5.2	0.0	PDE	EQ	A	23:05-23:17	13	20072- 7
1355	83	07	18	199	01:35:19.6	0.042N	121.641E	MINAHASSA PENINSULA	51	5.1	0.0	PDE	EQ	A	01:39-01:50	12	20072- 8
1356	83	07	18	199	03:14:14.7	0.110S	121.697E	MINAHASSA PENINSULA	62	5.4	0.0	PDE	EQ	A	03:18-03:29	12	20072- 9
1357	83	07	18	199	05:11:35.1	37.253N	141.613E	NEAR E COAST OF HONSHU JAPAN	42	5.2	0.0	PDE	EQ	ABDE	05:12-05:54	43	20072-10
1358	83	07	18	199	05:28:06.5	0.128S	121.727E	MINAHASSA PENINSULA	62	5.0	0.0	PDE	EQ	A	05:32-05:43	12	20072-10
1359	83	07	18	199	07:27:56.8	0.114S	121.787E	MINAHASSA PENINSULA	62	5.4	0.0	PDE	EQ	A	07:31-07:43	13	20072-11
1360	83	07	18	199	09:41:20.2	0.040S	121.742E	MINAHASSA PENINSULA	54	5.1	0.0	PDE	EQ	A	09:45-09:56	12	20072-12
1361	83	07	18	199	12:49:33.2	0.178S	121.692E	MINAHASSA PENINSULA	63	5.0	0.0	PDE	EQ	A	12:53-13:04	12	20072-13
1362	83	07	18	199	13:40:26.3	0.031S	121.649E	MINAHASSA PENINSULA	75	5.3	0.0	PDE	EQ	A	13:44-13:55	12	20072-14
1363	83	07	18	199	14:57:52.6	0.066S	121.743E	MINAHASSA PENINSULA	62	5.1	0.0	PDE	EQ	A	15:01-15:13	13	20072-15
1364	83	07	18	199	10:09:03.6	33.677N	136.739E	NEAR S COAST OF SOUTH HONSHU	366	5.0	0.0	PDE	EQ	ABDE	10:10-10:54	45	20072-16
1365	83	07	18	199	10:10:20.0	0.017S	121.740E	MINAHASSA PENINSULA	43	5.1	0.0	PDE	EQ	A	10:13-10:25	12	20072-16
1366	83	07	18	199	23:31:47.7	0.004N	121.730E	MINAHASSA PENINSULA	46	5.1	0.0	PDE	EQ	A	23:35-23:46	12	20072-17
1367	83	07	19	200	02:01:01.4	0.199S	121.622E	MINAHASSA PENINSULA	70	5.1	0.0	PDE	EQ	A	02:05-02:16	12	20072-18
1368	83	07	19	200	06:09:20.6	18.950S	177.598E	FIJI ISLANDS	33	5.1	4.8	PDE	EQ	A	06:12-06:23	12	20072-19
1369	83	07	19	200	08:03:46.0	0.043S	121.661E	MINAHASSA PENINSULA	57	5.1	0.0	PDE	EQ	A	08:07-08:18	12	20072-21
1370	83	07	19	200	10:00:03.0	0.132S	121.733E	MINAHASSA PENINSULA	44	5.2	0.0	PDE	EQ	A	10:04-10:15	12	20072-22
1371	83	07	19	200	11:42:06.6	0.096S	121.627E	MINAHASSA PENINSULA	65	5.1	0.0	PDE	EQ	A	11:46-11:57	12	20072-23
1372	83	07	19	200	12:42:56.1	0.086S	121.655E	MINAHASSA PENINSULA	57	5.0	0.0	PDE	EQ	A	12:46-12:58	13	20072-24
1373	83	07	19	200	14:18:00.6	0.093S	121.718E	MINAHASSA PENINSULA	55	5.0	0.0	PDE	EQ	A	14:22-14:33	12	20072-25
1374	83	07	19	200	15:11:02.3	0.138S	121.612E	MINAHASSA PENINSULA	64	5.0	0.0	PDE	EQ	A	15:15-15:26	12	20072-26
1375	83	07	19	200	17:07:05.9	30.368N	138.465E	SOUTH OF HONSHU JAPAN	435	4.6	0.0	PDE	EQ	ABDE	17:07-17:49	43	20072-27
1376	83	07	19	200	18:22:24.1	0.170S	121.674E	MINAHASSA PENINSULA	50	5.1	0.0	PDE	EQ	A	18:26-18:37	12	20072-28
1377	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO,SO,T.	0	0.0	0.0	HEL	EQ	BDE	20:33-21:02	30	20073- 1
1378	83	07	19	200	23:14:30.0	0.152S	121.646E	MINAHASSA PENINSULA	56	5.0	0.0	PDE	EQ	A	23:18-23:29	12	20073- 2
1379	83	07	19	200	23:49:19.1	1.006N	123.885E	MINAHASSA PENINSULA	299	5.5	0.0	PDE	EQ	A	23:52-00:03	12	20073- 3
1380	83	07	20	201	10:33:53.0	0.020S	121.640E	MINAHASSA PENINSULA	53	5.0	0.0	PDE	EQ	A	10:37-10:49	13	20073- 4
1381	83	07	20	201	22:57:17.8	5.953N	127.491E	PHILIPPINE ISLANDS REGION	34	5.6	5.1	PDE	EQ	A	23:00-23:11	12	20073- 5
1382	83	07	21	202	13:17:51.5	0.057S	121.682E	MINAHASSA PENINSULA	42	5.2	0.0	PDE	EQ	A	13:21-13:33	13	20073- 6
1383	83	07	22	203	01:32:17.9	6.171S	154.474E	SOLOMON ISLANDS	51	4.8	0.0	PDE	EQ	ABD	01:33-01:48	16	20073- 7

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT NO	YR	MO	DA	JUL	ORIGIN TIME HR:MN:SECS	LAT	LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	MAGNI SRF	INF SRC	EV TP	PHASES	SAVED INTERVAL	MNS	STRIP TAPE-FIL
1384	83	07	22	203	02:25:40.2	0.052S	121.717E	MINAHASSA PENINSULA	53	5.0	0.0	PDE	EQ	A	02:29-02:40	12	20073- 8
1385	83	07	22	203	02:36:43.9	14.662S	167.251E	VANUATU ISLANDS	193	5.4	0.0	PDE	EQ	ABDE	02:38-03:26	49	20073- 8
1386	83	07	22	203	02:39:55.3	36.223N	120.395W	CENTRAL CALIFORNIA	7	6.0	5.7	PDE	EQ	ABD	02:46-03:10	25	20073- 8
1387	83	07	22	203	06:36:14.6	0.190S	121.670E	MINAHASSA PENINSULA	32	5.1	0.0	PDE	EQ	A	06:40-06:51	12	20073- 9
1388	83	07	23	204	08:29:40.0	0.143S	121.619E	MINAHASSA PENINSULA	46	5.2	0.0	PDE	EQ	A	08:33-08:44	12	20073-10
1389	83	07	23	204	08:56:13.4	0.223S	121.596E	MINAHASSA PENINSULA	62	5.1	0.0	PDE	EQ	A	09:00-09:11	12	20073-11
1390	83	07	23	204	15:06:48.4	12.441N	144.001E	SOUTH OF MARIANA ISLANDS	41	4.9	0.0	PDE	EQ	ABD	15:07-15:20	14	20073-12
1391	83	07	23	204	22:57:24.2	0.133S	121.681E	MINAHASSA PENINSULA	62	5.1	0.0	PDE	EQ	A	23:01-23:12	12	20073-13
1392	83	07	24	205	00:52:25.5	27.904S	176.400W	KERMADEC ISLANDS REGION	73	5.3	0.0	PDE	EQ	A	00:56-01:07	12	20073-14
1393	83	07	24	205	05:59:35.2	43.693N	150.370E	KURIL ISLANDS REGION	33	5.0	0.0	PDE	EQ	ABDE	06:00-06:42	43	20073-15
1394	83	07	24	205	09:40:44.1	6.183S	154.634E	SOLOMON ISLANDS	414	4.9	0.0	PDE	EQ	ABDE	09:41-10:23	43	20073-16
1395	83	07	24	205	10:58:37.8	51.921N	158.926E	NEAR EAST COAST OF KAMCHATKA	65	4.6	0.0	PDE	EQ	ABD	11:00-11:16	17	20073-17
1396	83	07	24	205	14:52:33.3	39.739N	139.453E	NEAR W COAST OF HONSHU JAPAN	190	5.2	0.0	PDE	EQ	ABDE	14:53-15:39	47	20073-18
1397	83	07	24	205	17:50:07.4	19.356S	176.076W	FIJI ISLANDS REGION	288	4.8	0.0	PDE	EQ	A	17:52-16:04	13	20073-19
1398	83	07	24	205	23:07:30.7	53.852N	158.391E	NEAR EAST COAST OF KAMCHATKA	101	6.1	0.0	PDE	EQ	ABDE	23:09-23:59	51	20073-20
1399	83	07	24	205	23:38:00.3	8.167S	119.579E	FLORES ISLANDS REGION	33	5.8	5.9	PDE	EQ	A	23:42-23:54	13	20073-22
1400	83	07	25	206	22:31:40.8	36.220N	120.390W	CENTRAL CALIFORNIA	8	5.6	5.3	PDE	EQ	A	22:37-22:48	12	20074- 1
1401	83	07	25	206	23:17:44.1	40.102N	139.001E	NEAR W COAST OF HONSHU JAPAN	33	5.0	0.0	PDE	EQ	ABDE	23:19-00:05	47	20074- 2
1402	83	07	26	207	11:01:59.2	0.044S	121.776E	MINAHASSA PENINSULA	57	5.2	4.0	PDE	EQ	A	11:05-11:17	13	20074- 3
1403	83	07	26	207	20:14:51.6	0.655N	120.076E	MINAHASSA PENINSULA	43	5.3	4.5	PDE	EQ	A	20:19-20:30	12	20074- 4
1404	83	07	28	209	01:40:33.3	28.149S	176.255W	KERMADEC ISLANDS REGION	31	5.6	5.4	PDE	EQ	A	01:44-01:56	13	20074- 5
1405	83	07	28	209	03:00:59.0	0.685N	120.090E	MINAHASSA PENINSULA	41	5.0	0.0	PDE	EQ	A	03:05-03:16	12	20074- 6
1406	83	07	28	209	09:58:11.1	43.725N	147.660E	KURIL ISLADS	34	5.2	5.0	PDE	EQ	ABDE	09:59-10:42	44	20074- 7
1407	83	07	28	209	15:06:44.4	42.005N	142.647E	HOKKAIDO JAPAN REGION	59	5.5	0.0	PDE	EQ	ABDE	15:08-15:52	45	20074- 8
1408	83	07	28	209	19:28:24.1	22.403S	171.430E	LOVALTY ISLANDS REGION	129	5.2	0.0	PDE	EQ	A	19:31-19:42	12	20074- 9
1409	83	07	29	210	11:25:27.8	6.752S	105.629E	SUNDA STRAIT	33	5.5	5.4	PDE	EQ	A	11:31-11:42	12	20074-10
1410	83	07	29	210	13:26:54.3	14.328N	146.518E	MARIANA ISLANDS	09	0.0	0.0	PDE	EQ	ABD	13:26-13:35	14	20074-11
1411	83	07	29	210	14:21:35.6	4.917S	145.376E	NEAR N COAST PAPUA NEW GUINEA	161	4.8	0.0	PDE	EQ	ABD	14:23-14:38	16	20074-12
1412	83	07	29	210	19:24:23.6	32.322N	140.887E	SOUTH OF HONSHU JAPAN	51	5.0	0.0	PDE	EQ	ABDE	19:25-20:05	41	20074-13
1413	83	07	29	210	20:25:58.7	5.394N	126.567E	MINDANAO PHILIPPINE ISLANDS	50	5.2	4.5	PDE	EQ	A	20:29-20:40	12	20074-14
1414	83	07	30	211	03:35:09.6	0.159S	121.720E	MINAHASSA PENINSULA	75	5.0	0.0	PDE	EQ	A	03:39-03:50	12	20074-15
1415	83	07	30	211	07:07:14.6	0.144S	121.709E	MINAHASSA PENINSULA	63	5.0	0.0	PDE	EQ	A	07:11-07:22	12	20074-16
1416	83	07	30	211	08:09:52.6	52.451N	170.580W	FOX ISLANDS ALEUTIAN ISLANDS	50	5.2	4.3	PDE	EQ	ABDE	08:12-09:03	52	20074-17
1417	83	07	30	211	11:24:41.7	56.414N	162.801E	NEAR EAST COAST OF KAMCHATKA	33	4.6	0.0	PDE	EQ	ABD	11:27-11:44	18	20074-18
1418	83	07	31	212	04:00:24.9	0.616N	120.103E	MINAHASSA PENINSULA	33	5.3	4.4	PDE	EQ	A	04:12-04:23	12	20074-19
1419	83	07	31	212	09:09:21.3	0.964N	123.931E	MINAHASSA PENINSULA	272	5.1	0.0	PDE	EQ	A	09:12-09:23	12	20074-20
1420	83	07	31	212	10:26:00.2	20.142S	126.869W	SOUTH PACIFIC OCEAN	10	6.0	5.3	PDE	EQ	ABD	10:33-11:02	26	20074-21
1421	83	07	31	212	11:57:50.0	20.120S	127.000W	SOUTH PACIFIC OCEAN	10	5.4	0.0	PDE	EQ	ABD	12:05-12:32	26	20075- 1
1422	83	07	31	212	16:32:33.9	5.620N	94.784E	NORTHERN SUMATERA	96	5.0	0.0	PDE	EQ	A	16:39-16:50	12	20075- 2
1423	83	07	31	212	21:05:10.5	19.247N	145.435E	MARIANA ISLANDS	163	5.0	0.0	PDE	EQ	ABDE	21:04-21:37	34	20075- 3
1424	83	08	01	213	03:14:55.7	16.921N	147.190E	MARIANA ISLANDS REGION	52	5.2	4.8	PDE	EQ	ABDE	03:14-03:45	32	20075- 4
1425	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO, SO, T	0	0.0	0.0	HEL	EQ	BDE	04:15-04:44	30	20075- 5
1426	83	08	01	213	06:01:57.1	3.391S	145.835E	NEAR N COAST PAPUA NEW GUINEA	33	5.0	5.1	PDE	EQ	ABDE	06:03-06:47	45	20075- 6
1427	83	08	01	213	11:14:42.9	0.086S	121.678E	MINAHASSA PENINSULA	62	5.2	0.0	PDE	EQ	A	11:18-11:29	12	20075- 7
1428	83	08	02	214	02:17:40.6	20.462N	122.170E	PHILIPPINE ISLANDS REGION	156	6.1	0.0	PDE	EQ	A	02:20-02:31	12	20075- 8
1429	83	08	02	214	06:00:00.2	45.174N	153.482E	KURIL ISLANDS REGION	68	5.4	0.0	PDE	EQ	ABDE	06:09-06:51	43	20075- 9
1430	83	08	02	214	12:43:39.2	7.191S	117.398E	BALI SEA	580	5.4	0.0	PDE	EQ	A	12:47-12:58	12	20075-10
1431	83	08	02	214	13:15:10.3	16.469S	177.615E	FIJI ISLANDS	33	5.1	0.0	PDE	EQ	A	13:17-13:29	12	20075-11
1432	83	08	02	214	22:07:54.7	27.370N	128.447E	RYUKYU ISLANDS	49	5.4	0.0	PDE	EQ	A	22:10-22:21	12	20075-12
1433	83	08	03	215	07:12:33.2	11.205S	162.380E	SOLOMON ISLANDS	33	4.9	0.0	PDE	EQ	ABD	07:14-07:29	16	20075-13
1434	83	08	03	215	13:33:00.0	37.119N	116.009W	SOUTHERN NEVADA	0	4.2	0.0	PDE	NX	A	13:39-13:50	12	20075-14
1435	83	08	03	215	18:17:44.3	17.360S	167.793E	VANUATU ISLANDS	49	5.4	5.5	PDE	EQ	ABDE	18:20-19:10	51	20075-15
1436	83	08	03	215	22:29:44.6	22.288S	7.463E	S ATLANTIC OCEAN GOOD ANTIPODE	10	5.1	0.0	PDE	EQ	A	22:38-22:57	20	20075-16
1437	83	08	03	215	23:18:29.6	21.624N	143.048E	MARIANA ISLANDS REGION	389	5.0	0.0	PDE	EQ	ABDE	23:18-23:53	36	20075-17
1438	83	08	03	215	23:25:27.6	21.669N	143.054E	MARIANA ISLANDS REGION	385	4.8	0.0	PDE	EQ	ABDE	23:25-00:00	36	20075-17
1439	83	08	04	216	15:15:16.0	8.274S	128.278E	TIMOR SEA	50	5.4	0.0	PDE	EQ	A	15:19-15:30	12	20075-18
1440	83	08	05	217	00:33:44.7	52.967N	159.770E	OFF EAST COAST OF KAMCHATKA	33	5.4	4.7	PDE	EQ	ABDE	00:35-01:24	50	20076- 1
1441	83	08	05	217	05:25:43.7	17.276S	167.791E	VANUATU ISLANDS	33	5.3	5.7	PDE	EQ	ABDE	05:28-05:18	51	20076- 2
1442	83	08	05	217	06:21:42.4	3.589S	62.171W	WESTERN BRAZIL	21	5.5	5.3	PDE	EQ	A	06:31-06:50	20	20076- 3
1443	83	08	05	217	07:02:41.3	17.216S	167.827E	VANUATU ISLANDS	33	5.2	5.2	PDE	EQ	ABDE	07:05-07:55	51	20076- 4
1444	83	08	05	217	08:29:32.3	7.727S	123.548E	BANDA SEA	274	4.8	0.0	PDE	EQ	A	08:33-08:44	12	20076- 5
1445	83	08	06	218	02:26:49.3	16.134N	93.886W	CHIAPAS MEXICO	86	5.6	0.0	PDE	EQ	A	02:35-02:46	12	20076- 6
1446	83	08	06	218	15:43:52.6	40.176N	24.728E	AEGEAN SEA	10	6.3	7.1	PDE	EQ	AF	15:46-17:47	120	20076- 7
1447	83	08	06	218	22:06:03.9	44.413N	149.100E	KURIL ISLANDS	33	5.2	0.0	PDE	EQ	ABDE	22:07-22:50	44	20076- 8
1448	83	08	06	218	22:37:54.9	6.556S	130.127E	BANDA SEA	161	5.8	0.0	PDE	EQ	A	22:41-22:52	12	20076- 8
1449	83	08	07	219	02:48:21.7	6.336S	149.236E	NEW BRITAIN REGION	54	4.9	4.4	PDE	EQ	ABD	02:49-03:05	17	20076- 9
1450	83	08	07	219	06:27:25.3	31.112N	140.540E	SOUTH OF HONSHU JAPAN	127	4.8	0.0	PDE	EQ	ABD	06:28-06:42	15	20076-10
1451	83	08	08	220	03:47:50.0	35.466N	138.911E	HONSHU JAPAN	33	5.8	5.3	PDE	EQ	ABDE	03:49-04:32	44	20076-11
1452	83	08	08	220	16:54:11.2	27.521S	13.332W	SOUTH ATLANTIC RIDGE	10	5.2	0.0	PDE	EQ	A	17:03-17:22	20	20076-12
1453	83	08	09	221	00:23:59.0	7.532S	128.273E	BANDA SEA	173	5.0	0.0	PDE	EQ	A	00:27-00:38	12	20077- 1
1454	83	08	09	221	18:21:10.6	0.399S	132.590E	WEST IRIAN REGION	33	5.2	5.0	PDE	EQ	ABDE	18:23-19:16	54	20077- 2
1455	83	08	09	221	22:33:36.2	5.794S	110.439E	JAVA SEA	660	5.1	0.0	PDE	EQ	A	22:36-22:49	12	20077- 3
1456	83	08	10	222	00:55:59.3	56.660N	152.362W	KODIAK ISLAND REGION	33	5.1	0.0	PDE	EQ	ABDE	00:59-02:02	64	20077- 4
1457	83	08	10	222	20:05:48.0	23.713S	176.024W	SOUTH FIJI ISLANDS	33	5.4	5.4	PDE	EQ	A	20:09-20:20	12	20077- 5
1458	83	08	11	223	01:35:39.8	25.955N	123.754E	NORTHEAST OF TAIWAN	206	5.0	0.0	PDE	EQ	A	01:38-01:49	12	20077- 6
1459	83	08	11	223	02:10:48.7	10.007S	118.775E	SOUTH OF SUMBAWA ISLAND	33	5.1	4.3	PDE	EQ	A	02:15-02:26	12	20077- 7
1460	83	08	11	223	12:03:01.8	18.814N	120.947E	LUZON PH'LIPPINE ISLANDS	39	5.4	5.4	PDE	EQ	A	12:06-12:17	12	20077- 8
1461	83	08	11	223	21:35:41.7	42.001N	142.245E	HOKKAIDO JAPAN REGION	71	4.9	0.0	PDE	EQ	ABD	21:37-21:52	16	20077- 9
1462	83	08	11	223	22:56:11.6	1.836N	127.335E	HALMAHERA	109	5.7	0.0	PDE	EQ	A	22:59-23:10	12	20077-10
1463	83	08	12	224	07:42:12.5	14.960N	119.042E	LUZON PHILIPPINE ISLANDS	33	5.0	5.1	PDE	EQ	A	07:45-07:57	13	20077-11
1464	83	08	13	225	02:27:48.5	53.513N	160.339E	NEAR EAST COAST OF KAMCHATKA	33	4.8	0.0	PDE	EQ	ABD	02:29-02:46	18	20077-12
1465	83	08	13	225	15:39:32.4	7.124S	129.477E	BANDA SEA	109	5.5	0.0	PDE	EQ	A	15:43-15:54	12	20077-13
1466	83	08	13	225	22:28:19.3	8.722S	111.237E	JAVA	79	5.9	0.0	PDE	EQ	A	22:33-22:45	13	20077-14
1467	83	08	14	226	12:01:45.5	4.719S	153.180E	NEW IRELAND REGION	69	4.9	0.0	PDE	EQ	ABD	12:02-12:17	16	20077-15
1468	83	08	14	226	14:11:43.0	12.990S	109.032W	NORTHERN EASTER I. CORDILLERA	10	5.3	0.0	PDE	EQ	ABD	14:20-14:50	31	20077-16
1469	83	08	14	226	16:20:12.6	17.201S	178.770W	FIJI ISLANDS REGION	524	5.1	0.0	PDE	EQ	A	16:22-16:33	12	20077-17
1470	83	08	14	226	19:56:39.2	63.336S	169.466E	BALLENY ISLANDS REGION	10	5.4	5.9	PDE	EQ	A	20:04-20:15	12	20077-18
1471	83	08	14	226	22:26:11.6	9.096S	123.775E	TIMOR	119	5.0	0.0	PDE	EQ	A	22:30-22:41	12	20077-19
1472	83	08	15	227	04:49:54.7	47.357N	153.169E	KURIL ISLANDS	82	5.0	0.0	PDE	EQ	ABDE	04:51-05:35	45	20077-20
1473	83	08	15	227	19:44:41.7	17.096S	174.594W	TONGA ISLANDS	211	5.5	0.0	PDE	EQ	A	19:47-19:58	12	20077-21
1474	83	08	16	228	00:33:44.7	12.290N	143.136E	SOUTH OF MARIANA ISLANDS	66	5.2	0.0	PDE	EQ	ABDE	00:34-01:10	37	20077-22
1475	83	08	16	228	05:20:29.6	0.073S	123.967E	MINAHASSA PENINSULA	126	5.2	0.0	PDE	EQ	A	05:24-05:35	12	20078- 1
1476	83	08	16	228	13:37:19.0	36.630N	141.167E	NEAR E COAST OF HONSHU JAPAN	63	5.1	0.0	PDE	EQ	ABDE	13:38-14:20	43	20078- 2
1477	83	08	16	228	16:29:01.3	4.700S	103.199E	SOUTHERN SUMATERA	59	5.1	0.0	PDE	EQ	A	16:35-16:46	12	20078- 3
1478	83	08	17	229	01:11:13.4	18.750N	145.374E	MARIANA ISLANDS	213	4.5	0.0	PDE	EQ	ABDE	01:10-01:43	34	20078- 4
1479	83	08	17	229	06:03:53.1	14.091S	166.886E	VANUATU ISLANDS	50	5.0	0.0	PDE	EQ	ABDE	06:05-06:52	48	20078- 5
1480	83	08	17	229	09:29:48.6	8.775S	111.125E	JAVA	61	5.4	0.0	PDE	EQ	A	09:35-09:46	12	20078- 6
1481	83	08	17	229	10:55:52.8	55.786N	161.212E	NEAR EAST COAST OF KAMCHATKA	55	6.5	6.7	PDE	EQ	ABDE	10:58-11:49	52	20078- 7
1482	83	08	17	229	12:17:55.9	18.159N	120.982E	LUZON PHILIPPINE ISLANDS	30	6.2	6.7	PDE	EQ	ABDE	12:21-13:19	59	20078- 8
1483	83	08	17	229	12:59:10.3	22.546S	174.330W	TONGA ISLANDS REGION	33	5.1	0.0	PDE	EQ	A	13:02-13:14	13	20078- 8

WAKE HYDROPHONE INFORMATION PROCESSING SYSTEM (WHIPS) EVENT LISTING 19 DEC 83

KEY: INFORMATION SOURCES - PDE=NEIS PDECARD, MON=NEIS MONTHLY LIST, ICS=ICS LIST, HEL=HELICORDER, OTH=OTHER
EVENT TYPE - EQ=EARTHQUAKE, NX=NUCLEAR EXPLOSION, SX=SCIENTIFIC EXPLOSION, OT=OTHER, UN=UNKNOWN
PHASES - A=P, B=PO, C=S, D=SO, E=T, F=OTHER

EVNT NO	YR	MO	DA	JUL	HR:MN:SECS	LAT	LON	LOCATION DESCRIPTION	DEP KM	MAGNI BDY	MAGNI SRF	INF SRC	EV TP	SAVED PHASES	SAVED INTERVAL	MNS	STRIP TAPE-FIL
1484	83	08	18	230	08:30:10.2	19.416S	172.779W	TONGA ISLANDS REGION	33	5.3	5.0	PDE	EQ	A	08:33-08:44	12	20078- 9
1485	83	08	18	230	09:42:30.1	3.835S	151.293E	NEW IRELAND REGION	33	5.2	0.0	PDE	EQ	ABDE	09:43-10:24	42	20078-10
1486	83	08	18	230	16:05:40.3	3.748S	151.344E	NEW IRELAND REGION	33	5.2	0.0	PDE	EQ	ABDE	16:05-16:47	42	20078-11
1487	83	08	18	230	16:09:58.6	73.373N	54.839E	NOVAYA ZEMLYA	0	5.9	4.1	PDE	NX	A	16:17-16:28	12	20078-11
1488	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO SO T	0	0.0	0.0	HEL	EQ	BDE	17:37-18:06	30	20078-12
1489	83	08	18	230	19:46:49.6	3.786S	151.190E	NEW IRELAND REGION	33	5.2	4.9	PDE	EQ	A	19:47-19:59	13	20078-13
1490	83	08	19	231	14:35:34.3	2.175N	127.078E	MOLUCCA PASSAGE	55	5.2	4.3	PDE	EQ	A	14:38-14:49	12	20078-14
1491	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE BONIN ISL. PO SO T	0	0.0	0.0	HEL	EQ	BDE	00:54-01:30	37	20078-15
1492	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE JAPAN PO SO T	0	0.0	0.0	HEL	EQ	BDE	05:24-06:05	42	20079- 1
1493	83	08	20	232	06:19:28.2	8.558S	117.569E	SUMBAWA ISLAND REGION	134	5.5	0.0	PDE	EQ	A	06:24-06:35	12	20079- 2
1494	83	08	20	232	13:08:31.7	27.860N	141.807E	BONIN ISLANDS REGION	35	5.8	5.5	PDE	EQ	ABDE	13:09-13:46	38	20079- 3
1495	83	08	20	232	14:48:30.2	50.865N	156.160E	KURIL ISLANDS	120	6.0	0.0	PDE	EQ	ABDE	14:50-15:37	48	20079- 4
1496	83	08	20	232	17:15:06.6	18.117S	179.734W	FIJI ISLANDS REGION	659	4.7	0.0	PDE	EQ	A	17:17-17:28	12	20079- 5
1497	83	08	20	232	17:15:24.4	39.328N	73.611E	TAJIK-XINJIANG BORDER REGION	33	4.9	4.4	PDE	EQ	A	17:22-17:34	13	20079- 5
1498	83	08	21	233	06:18:55.0	4.519N	127.789E	TALAUD ISLANDS	83	5.0	0.0	PDE	EQ	A	06:21-06:33	13	20079- 6
1499	83	08	21	233	08:34:45.8	3.714N	126.620E	TALAUD ISLANDS	48	5.8	5.6	PDE	EQ	A	08:37-08:49	13	20079- 7
1500	83	08	21	233	17:21:13.6	7.384S	121.185E	FLORES SEA	541	5.1	0.0	PDE	EQ	A	17:25-17:36	12	20079- 8
1501	83	08	21	233	18:58:19.2	28.782S	112.653W	EASTER ISLAND REGION	10	5.4	5.5	PDE	EQ	A	19:06-19:18	13	20079- 9
1502	83	08	21	233	22:57:31.4	23.481S	177.188W	SOUTH OF FIJI ISLANDS	169	5.5	0.0	PDE	EQ	A	23:00-23:12	13	0- 0
1503	83	08	22	234	04:58:11.9	31.888N	141.710E	SOUTH OF HONSHU JAPAN	33	4.5	0.0	PDE	EQ	ABD	04:59-05:13	15	0- 0
1504	83	08	22	234	05:53:26.8	14.827S	166.969E	VANUATU ISLANDS	112	5.5	0.0	PDE	EQ	ABDE	05:55-06:43	49	0- 0
1505	83	08	22	234	09:09:42.3	7.019S	130.811E	TANIMBAR ISLANDS REGION	33	5.8	0.0	PDE	EQ	A	09:13-09:24	12	20080- 1
1506	83	08	22	234	12:38:21.4	7.208N	34.422W	CENTRAL MID-ATLANTIC RIDGE	10	5.1	0.0	PDE	EQ	A	12:47-13:07	21	20080- 2
1507	83	08	22	234	12:39:06.7	53.861N	160.493E	NEAR EAST COAST OF KAMCHATKA	33	5.4	0.0	PDE	EQ	ABDE	12:41-13:30	50	20080- 2
1508	83	08	22	234	23:00:42.5	16.209S	167.903E	VANUATU ISLANDS	185	5.1	0.0	PDE	EQ	ABDE	23:02-23:52	51	20080- 3
1509	83	08	22	234	23:16:38.0	3.587S	146.644E	BISMARCK SEA	29	5.4	5.5	PDE	EQ	ABDE	23:18-00:01	44	20080- 3
1510	83	08	23	235	11:15:16.9	5.917S	150.996E	NEW BRITAIN REGION	52	5.1	4.0	PDE	EQ	ABDE	11:16-11:59	44	20080- 4
1511	83	08	23	235	12:12:16.9	24.567N	95.200E	BURMA	126	5.1	0.0	PDE	EQ	A	12:18-12:29	12	20080- 5
1512	83	08	23	235	23:39:41.0	5.912S	151.068E	NEW BRITAIN REGION	51	5.3	5.8	PDE	EQ	ABDE	23:41-00:23	43	20080- 6
1513	83	08	24	236	13:36:30.9	40.305N	124.767W	NEAR COAST OF NORTHERN CALIF	30	5.5	5.7	PDE	EQ	ABDE	13:42-14:59	78	20080- 7
1514	83	08	24	236	20:19:51.3	3.627N	122.258E	CELEBES SEA	621	4.8	0.0	PDE	EQ	A	20:22-20:33	12	20080--8
1515	83	08	25	237	00:12:58.0	5.427S	150.919E	NEW BRITAIN REGION	112	5.1	0.0	PDE	EQ	ABDE	00:14-00:56	43	20080--9
1516	83	08	25	237	07:03:08.3	5.945S	151.008E	NEW BRITAIN REGION	48	5.5	0.0	PDE	EQ	ABDE	07:04-07:47	44	20080-10
1517	83	08	25	237	11:05:30.8	39.152N	74.052E	SOUTHERN XINJIANG CHINA	33	5.0	4.9	PDE	EQ	A	11:13-11:24	12	20080-11
1518	83	08	25	237	20:23:32.6	33.490N	131.430E	KYUSHU JAPAN	121	6.1	0.0	PDE	EQ	ABDE	20:25-21:14	50	20080-12
1519	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE BONIN ISL. PO SO T	0	0.0	0.0	HEL	EQ	BDE	01:13-01:52	40	20081- 1
1520	83	08	26	238	02:34:34.8	2.847S	139.097E	NEAR N COAST OF WEST IRIAN	76	5.4	0.0	PDE	EQ	A	02:36-02:47	12	20081- 2
1521	83	08	26	238	08:18:15.1	3.684N	127.143E	TALAUD ISLANDS	33	5.2	0.0	PDE	EQ	A	08:21-08:32	12	20081- 3
1522	83	08	26	238	18:20:32.8	20.705S	169.583E	VANUATU ISLANDS	100	5.3	0.0	PDE	EQ	ABDE	18:23-19:17	55	20081--4
1523	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS PO SO T	0	0.0	0.0	HEL	EQ	BDE	01:49-02:29	41	20081- 5
1524	83	08	27	239	04:14:28.8	20.640S	178.823W	FIJI ISLANDS REGION	628	4.7	0.0	PDE	EQ	A	04:16-04:28	13	20081- 6
1525	83	08	27	239	11:50:29.8	8.174N	126.005E	MINDANAO PHILIPPINE ISLANDS	55	5.2	0.0	PDE	EQ	A	11:53-12:04	12	20081- 7
1526	83	08	27	239	12:31:40.9	85.517N	90.603E	NORTH OF SEVERNAYA ZEMLYA	10	4.7	4.8	PDE	EQ	A	12:38-12:49	12	20081--8
1527	83	08	27	239	18:49:50.3	8.186N	125.962E	MINDANAO PHILIPPINE ISLANDS	33	5.5	6.0	PDE	EQ	ABDE	18:50-19:49	60	20081- 9
1528	83	08	28	240	11:30:14.7	46.197N	151.544E	KURIL ISLANDS	75	5.5	0.0	PDE	EQ	ABDE	11:31-12:15	45	20081-10
1529	83	08	28	240	13:19:32.5	44.972N	148.771E	KURIL ISLANDS	33	5.0	0.0	PDE	EQ	ABDE	13:20-14:04	45	20081-**
1530	83	08	29	241	05:19:24.5	3.430S	148.891E	BISMARCK SEA	33	5.2	5.8	PDE	EQ	ABDE	05:20-06:02	43	20081-12
1531	83	08	29	241	10:10:31.0	35.830N	121.353W	CENTRAL CALIFORNIA	8	5.3	0.0	PDE	EQ	ABDE	10:16-11:37	82	20082- 1
1532	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE KURILS	0	0.0	0.0	HEL	EQ	BDE	10:12-10:54	43	20082- 1
1533	83	08	29	241	15:36:13.6	9.561N	126.337E	MINDANAO PHILIPPINE ISLANDS	49	5.3	4.1	PDE	EQ	A	15:39-15:50	12	0- 0
1534	83	08	30	242	05:57:01.5	6.368S	130.485E	BANDA SEA	136	5.1	0.0	PDE	EQ	A	06:00-06:11	12	0- 0
1535	83	08	30	242	06:50:16.6	16.683S	172.075W	SAMOA ISLANDS REGION	35	6.1	5.7	PDE	EQ	ABD	08:53-09:11	19	0- 0
1536	83	08	30	242	10:39:27.3	25.071N	94.722E	BURMA-INDIA BORDER REGION	63	5.6	0.0	PDE	EQ	A	10:45-10:56	12	0- 0
1537	83	08	30	242	22:15:59.6	9.558S	158.818E	SOLOMON ISLANDS	76	5.0	0.0	PDE	EQ	ABDE	22:17-23:00	44	0- 0
1538	83	08	31	243	19:40:11.2	12.514N	144.238E	SOUTH OF MARIANA ISLANDS	33	4.3	3.9	PDE	EQ	ABDE	19:40-20:15	36	0- 0
1539	83	08	31	243	22:20:07.4	53.503N	163.622W	UNIMAK ISLAND REGION	33	5.1	0.0	PDE	EQ	A	22:23-22:34	12	0- 0
1540	00	00	00	000	00:00:00.0	0.000N	0.000E	PROBABLE MARIANAS	0	0.0	0.0	HEL	EQ	BDE	09:21-09:54	34	0- 0
1541	83	09	01	244	14:00:02.0	37.273N	116.355W	SOUTHERN NEVADA	0	5.4	0.0	PDE	NX	A	14:06-14:17	12	0- 0
1542	83	09	02	245	03:05:46.2	36.624N	140.932E	NEAR E COAST OF HONSHU JAPAN	68	5.1	0.0	PDE	EQ	ABDE	03:06-03:49	44	0- 0
1543	83	09	02	245	04:09:39.8	52.363N	175.517W	ANDREANOF ISL. ALEUTIAN ISL.	112	4.7	0.0	PDE	EQ	ABD	04:11-04:28	18	0- 0

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